MUNICIPAL ENGINEERING

The World's Leading Municipal Publication.

CONSTRUCTING *a modern highway, Farr Bros., Chicago, Contractors.*

VOL. XLIV. APRIL, 1913. No. 4.

Staff organization, as defined by Mr. Harrington Emerson, is that part of organization machinery which brings ideas and plans to the corporation from outside sources. From such information new methods and higher efficiency are instituted.

It is the function of this publication to act as the staff organization for its thousands of subscribers, to place before them new ideas, and to give them information from all parts of the country that will be adaptable to their business in the promotion of higher efficiency.

Published by

Engineering Publishing Co.

INDIANAPOLIS, IND.

New York Office:
1125 World Bldg.
F. E. LISTER
FRANK W. MAAS
Eastern Managers.

Entered at Postoffice, Indianapolis, as Second-Class Matter.

Chicago Office:
1945 Com'l Nat'l Bank Bldg.
CHAS. A. DICKENS,
Western Manager.

Russell Fortune, Prest. **C. C. Brown, Editor.** **C. S. Sale, Gen'l Mgr.**

Subscription Price in U. S. and Possessions, Cuba and Mexico, $2.00. Canada, $2.40. Foreign, $2.75.

Changes of address, subscriptions, remittances and editorial matter should be addressed to MUNICIPAL ENGINEERING, Indianapolis, Ind.

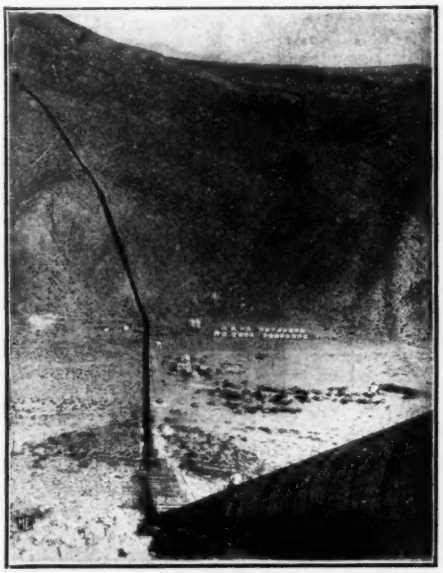
WILLIAM MULHOLLAND, *Chief Engineer of the aqueduct, in a characteristic attitude.*

COMPLETION OF THE LOS ANGELES AQUEDUCT

By Burt A. Heinly, Los Angeles Water Department.

The completion of the great Los Angeles aqueduct almost simultaneously with the publication of this number of MUNICIPAL ENGINEERING, *makes this article by a member of the official family of the Bureau of Water Works and Supply of the Los Angeles Department of Public Service very timely and the collection of photographs of various features of the work most interesting. The "Big Chief" is caught in a characteristic attitude and the "Big Ditch" is shown in its magnitude and the dignity, beauty, and magnificence of its surroundings. The views show as well the enormous difficulties that were met, the natural obstacles of desert, mountain and canon which were overcome, and give some hints of the ingenious and marvelous methods used in this beneficial application of science to the control of the forces of nature, which is engineering in the highest meaning of that term.*

SOUTHERN California is topographically a country of rough contours and steep gradients, or slopes, and this condition would be considered, ordinarily, as the least favorable for retention of the flood water of the higher altitudes, but curiously, the very violence of the action induced by these steep slopes on the falling waters tends to supply the medium by which they are retained.

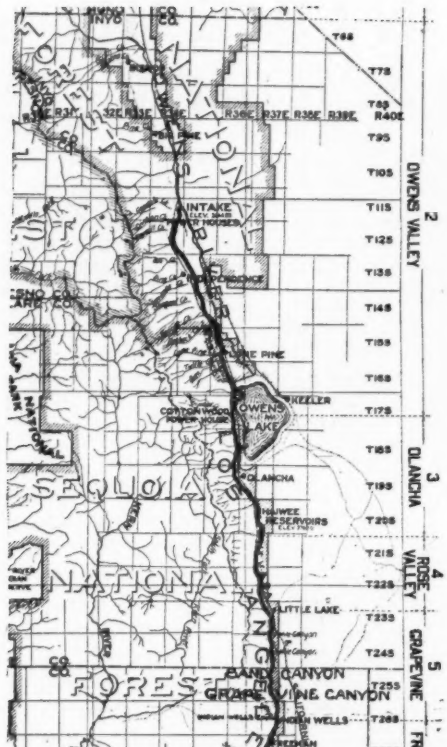


THE JAWBONE SIPHON. *Note sections of pipe in valley and railroad alongside pipe line, with car in bottom of valley loaded with section of pipe.*

Our higher mountains are mainly composed of granite of a coarsely crystaline structure which is readily fractured by variations of temperature on its surface. The fragments so produced are washed down in large volume and spread out in great delta fans in the valleys and these deposits are so porous in their nature as to afford incredible space for the reception of water. These fragmental deposits, notwithstanding their great porosity, offer such resistance to the free flow of water sinking into them that they prevent its rapid escape down the slope. Indeed, it is a common thing to find slopes in these gravel-contained waters as steep as from forty to fifty feet to the mile and yet the velocity of the water as measured by the observed discharge from them may be as low as eight to twelve feet per day.

It is due to these agencies that the very irregular precipitation, which in an average year does not exceed 15.6 inches and ninety-six per cent. of which falls from October 1 to April 30, is regulated so as to afford a fairly even and reliable water supply.

The water so conserved in gravels and sands is naturally held under the most favorable conditions, not only for the prevention of loss thru evaporation, but also for the preservation of its purity, as it is fully protected from surface contamination. In point of fact, in addition to its function as a reservoir, the great mass of detritus acts as a most effective and complete filter.



Map of the Los Angeles Aqueduct.

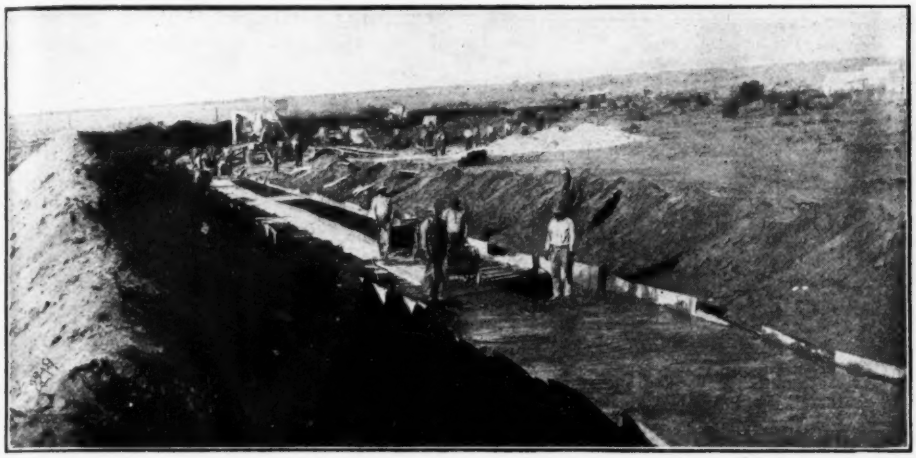
Underground Supply Dwindles

During the winter of 1897-98 we experienced the first seven successive years of scanty rainfall. In the year following the streams began to dwindle in size. Forthwith began the erection of steam pumping plants to make up the deficiency from the underground reservoirs such as I have just described. Finding that this was a cheap, efficient and dependable source of supply, the Californian, no less avaricious than any other average man, provided water not only for his lands then under cultivation but extended his ditches and ran the water from this source farther and farther into the dry lands. The gasoline pumping engine, too, played a most important part in this development. The invention had just been

A SIPHON LINE *under construction. Note the sections in the foreground ready to adjust and rivet to the line.*

made a commercial success and California irrigators were among the first to seize upon the idea. The farmer could start the engine in the morning, then go about his work, and all day long a sparkling stream poured into the irrigation ditches. Wells were put down by the hundred.

Since the founding of the pueblo in 1781 by the Mission Fathers, Los Angeles has taken her domestic water supply from the Los Angeles river—a stream that rises in the southern slopes of the Sierra Madres, flows in a southerly direction thru the San Fernando Valley and when in flood reaches the ocean. At other times the surface flow of this river is



RECTANGULAR SECTION OF CONDUIT *under construction on the Mojave division. Placing concrete on the forms for the roof. There are ninety-eight miles of this class of work.*

wholly diverted into the intakes of the city water system and from the city to the sea the river's course becomes a dry and sandy wash.

In the early days of the pueblo, there was water for all from the Rio Porciungula, as the river was then called, but little by little the pueblo grew from a village into a town and into a thriving city. By degrees the land which had been submerged became urban and in the same territory where once the water was devoted to irrigation it was now taken for domestic use until the whole surface flow of the stream was passing into the city's pipe system.

The seven years of drouth affected the flow of the Los Angeles river in the same way that it did all other streams of the Pacific coastal plain, and the city, just as the irrigators were doing, began the development of an additional supply from the subterranean flow of the river. Galleries were driven in the water bearing gravels at right angles to this flow. The city's supply was considerably enlarged thereby, for a time.

The painstaking investigation of our underground water supply which the United States Government Reclamation Service conducted proved the shrinkage by the inroads made upon it. The city had abundant evidence of the conditions by the gradual diminution of the flow in the Los Angeles river.

The city in 1902 was consuming about 23,000,000 gallons daily. Even with the reduction of waste this had increased in 1905 to 30,000,000 gallons. With the fullest possible development of the surface and subterranean flow of the river we could not hope to procure more than 50,000,000 gallons daily under normal conditions and this would shrink to smaller limits in cycles of dry years. It was inevitable that the city would expand. Not only was its population going to become more dense within the limits that then existed but the limits were going to be extended widely.

Municipal Ownership Begins

Los Angeles began the municipal ownership and operation of its water works in February, 1902, and almost immediately the search was begun for a supplementary medium of supply. All possible sources along the coastal plain to the south were examined. All were rejected. The water of every stream was already appropriated. Every one was serving a purpose of the highest importance in nourishing and supplying valued improvements consisting of towns and orchards. Even had it been possible, it was not desirable to condemn these water supplies and reservoirs and restore to

STEAM SHOVEL, *with extra long boom, on open conduit. Olancha division, near Owens Lake.*

desert conditions the lands that were cultivated and improved and that served to aid the city's wealth and prosperity.

New Supply Found

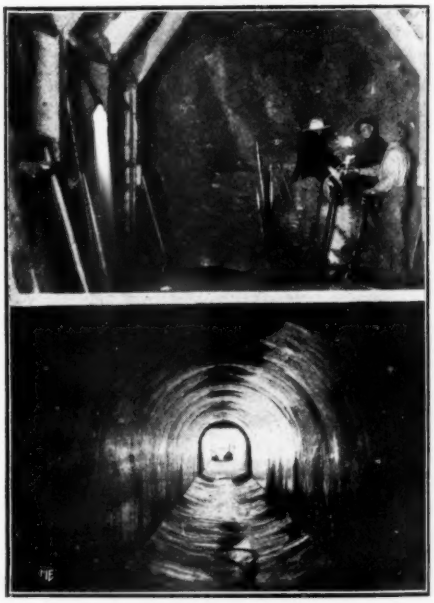
But far to the northward there was a place where water was going to waste—rolling by thousands of inches into a saline lake to be evaporated by the dessicating winds of the desert and to be lost to humanity forever. To this new source the city of Los Angeles has gone not only for water at present demanded but for the wealth that this new supply will bring in power development and in irrigation along the coastal plain.

The obstacles presenting themselves might well have daunted a city of even greater courage than this metropolis of the Southwest. A mountain wall intervened and beyond lay 150 miles of inhospitable desert shut in by bare and forbidding mountain ranges. The point on the Owens river in Inyo county, California, where the first surveyor's stakes were placed for intake of the proposed aqueduct is 250 miles distant.

Los Angeles undertook the task of constructing this great water conduit because she had no other alternative. That was seven years ago. Almost simultaneously with the publication of this article the waters of the Owens river and tributary streams flowing down the eastern face of the Sierra will be sweeping thru the long steel and concrete water course to the impounding reservoir at the head of the San Fernando Valley, 20 miles from the city's gates, and from here plans for one of the projected pipe lines are now being completed to carry a copious supply into the municipal distributing system.

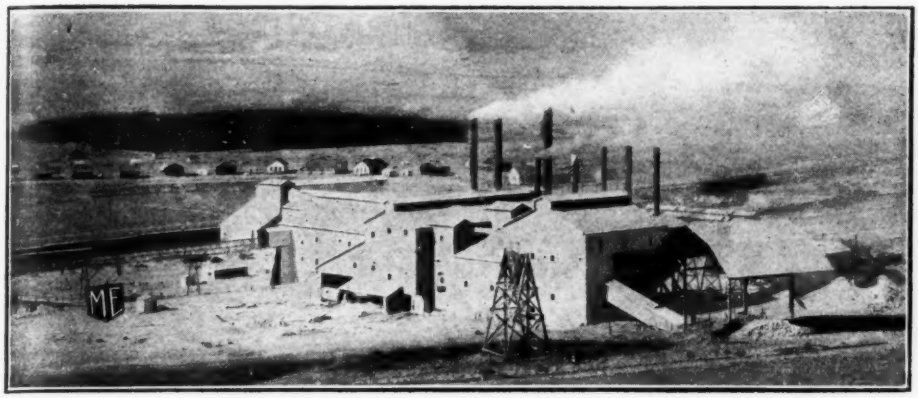
Owens River Water Taken

The Owens river has its head waters in the High Sierra not far from Yosemite Park and flows southward thru the Owens Valley to empty into saline Owens Lake. Its drainage area of 3,000 miles of rugged, snow-capped granite mountains affords a sure and copious water supply of which there need never be any fear of human contamination. From this river and the many streams that debouch from the Sierra for 50 miles along the course of the aqueduct, Los Angeles is preparing to take a supply, day in and day out, of 20,000 miner's inches or 258,000,000 gallons per twenty-four hours. Moreover by



ELIZABETH TUNNEL.
Drilling back at the face, two miles in. Completed and lined tunnel section.

the acquisition of 25,000 acres of artesian lands contiguous to the aqueduct and the river, the city is guarded against any possible period of long continued drouth by a reserve supply that can be developed to the extent of 10,000 miner's inches. In quality the aqueduct supply will have the same sparkling clearness and purity of



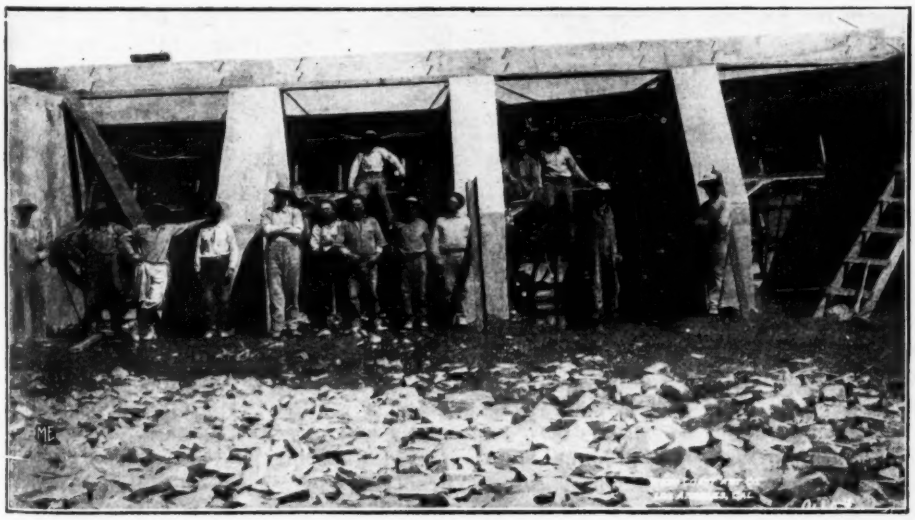
THE CEMENT PLANT *built to manufacture the cement for the aqueduct. This plant cost* $850,000 *and the city saved money by building it.*

the water now being served, but the mineral content will be only half that of the Los Angeles river, which approximates 30 grains to the U. S. gallon.

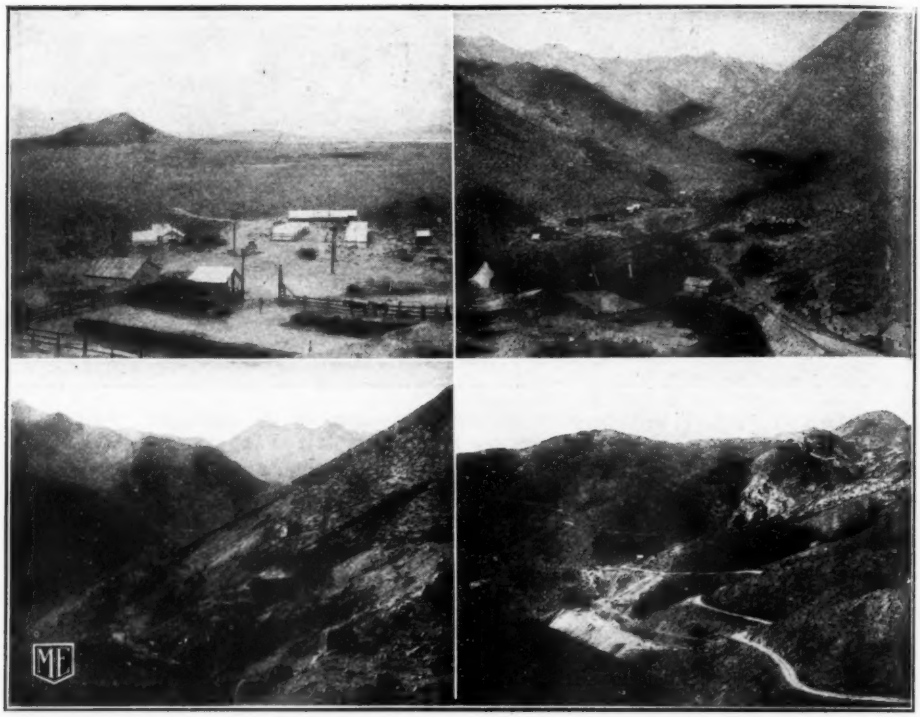
Bonds Voted

In 1905 Los Angeles voted the first bond issue of $1,500,000 for the purchase of Owens river water rights and the preliminary engineering features of the undertaking. When the plans and estimates had been approved by a board of consulting engineers, comprising John R. Freeman, Frederic P. Stearns and James Dix Schuyler, the city voted an additional $23,000,000 for the completion of the work.

The $23,000,000 bond issue was authorized by the people June 13, 1907. Excavation of the Elizabeth tunnel, the 26,870-foot bore thru which the water is to be carried beneath the crest of the Sierra Madre range, was begun almost immediately afterwards, for at that time this was believed to be the dominating feature in determining the time of completion for the whole work. Other than this, no aqueduct excavation was attempted for a period of eighteen months. The whole



HYDRAULIC INTAKE GATES *by which water of Owens River is regulated in its passage into the aqueduct. The picture was taken upon completion of the gates, the river being walled off by a temporary dam.*



ROSE VALLEY *division construction camp, where mountains are as desolate as the desert and as far from civilization.*

GRAPE VINE CANYON. *Rectangular concrete aqueduct section. The steam shovel had to be taken apart and lifted up to the line, reassembled, and set to work.*

SAND CANYON *construction camp, typical of deep depressions on aqueduct line crossed by steel pipe line eight to eleven feet in diameter.*

JAWBONE SECTION, *Pickle Hills. The roads cost* $5,000 *per mile. This twenty-three miles is the roughest on the line and is nearly all in tunnel.*

energy of the organization then formed was devoted to the preliminaries of thoro preparation.

Vast Preliminary Work

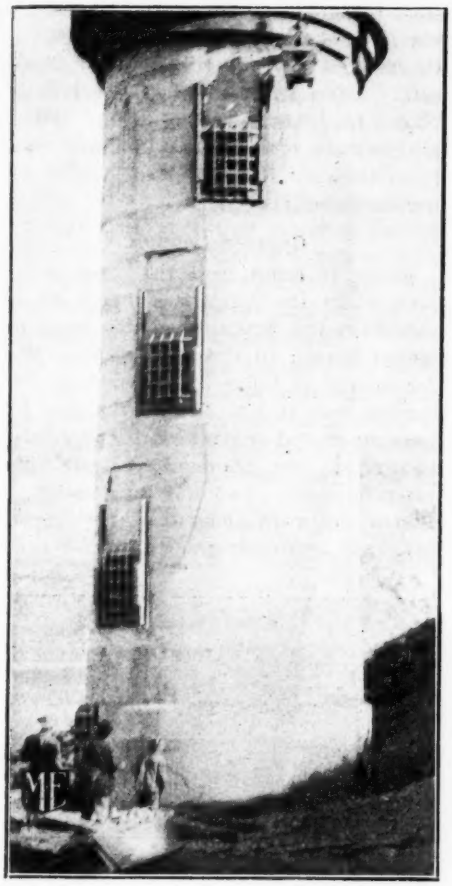
It is not my purpose to enter upon a detailed description of this phase of the undertaking, which of itself encompassed what has really been one of the most difficult phases of the work. Suffice it to say that the longer part of the aqueduct zone at the inauguration of the task was from 35 to 70 miles from any railroad. The best means of transportation and communication was a four-horse stage coach making tri-weekly journeys across the desert and connecting the town of Mojave on the Southern Pacific and Santa Fe railroads with Keeler, the terminus of the Colorado and Nevada narrow gage, near the mouth of the Owens Valley. Stage stations at twenty-mile intervals marked the only places of permanent human habitation along the 120 miles of trail. The city entered into a contract with the Southern Pacific Company for the construction and operation of a standard gage steam railroad to replace the stage coach and the corporation in 1907 began and carried to rapid completion this necessary improvement.

The city's forces busied themselves in the construction of 315 miles of roads and trails, and 150 miles of lines for the erection of a copper line telephone system from the central offices in Los Angeles to the most distant point of the work; the construction of three hydro-electric power plants on streams in the Owens Valley and a transmission line of high

voltage along the zone to transmit the energy for the lighting of camps and for driving the excavating machinery.

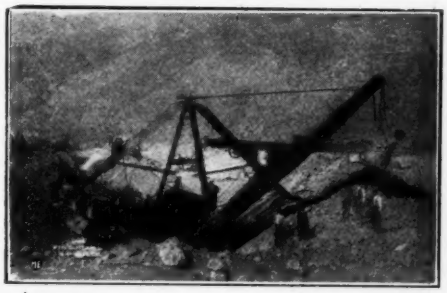
Cement Plant Built

In addition the city undertook the manufacture of cement at a point adjacent to the line of the aqueduct and ex-



GATE HOUSE *in Haiwee Reservoir to regulate flow of water in the aqueduct to the south.*

pended $850,000 in this phase of the enterprise alone. It was a wise undertaking on the part of the Board of Public works for not only has the city been able to procure cement at a reduced rate but the work has not been delayed for lack of the material of which over one million barrels has already been required; large savings in freight have resulted and the Aqueduct Bureau has been enabled to carry on scientific investigations and adopt the use of tufa cement at large financial saving.



ELECTRIC SHOVEL *on Olancha division. Huge boulders made progress slow.*

In the year and a half, hundreds of buildings required for the housing of men, animals and machinery went up as if by magic. All in all the city expended nearly $4,000,000 in the work of preparation.

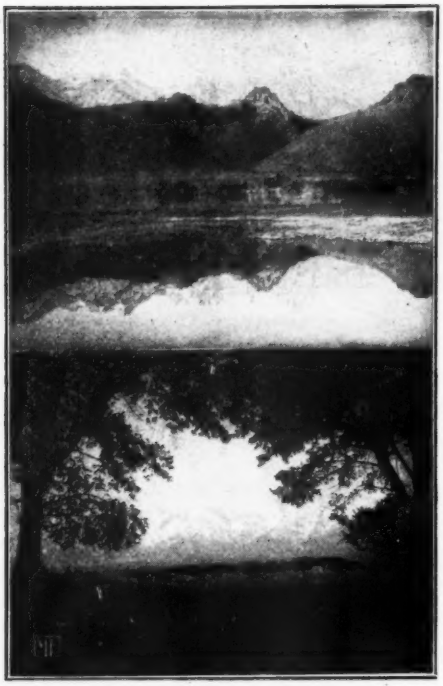
The Aqueduct

The Los Angeles aqueduct in its completed form comprises a proposed system of five storage and regulating reservoirs and 215.21 miles of conduit, exclusive of the 10.05 miles being constructed in San Francisquito canon for power development.

The aqueduct at the point where the flow of the Owens river is diverted into it has an elevation of 3,812 feet, and is a gravity system thruout. The river and the headgates are shown in two of the accompanying photographs. The first 21 miles consist of an open unlined canal having a width of 65 feet on the bottom. This canal, which follows nearly the general floor of the valley, has a capacity of 900 second feet and will carry not alone the waters of the river but will receive the flow of several of the river's tributaries and collect a quantity of the underground flow of the valley as well. A hydraulic dredge is shown in one photograph, excavating this canal.

Open Ditch

At the toe of the Alabama Foothills the aqueduct assumes the form of a concrete-lined open ditch having a carrying capacity of 1,000 second feet to provide for additional stream diversions. This con-



MOUNT WHITNEY, 14,502 *feet high, in background, Alabama foothills and Lake Diaz.*

MOUNT WILLIAMSON, *back of Independence, and part of Sierra Range, forming water shed of Owens River.*

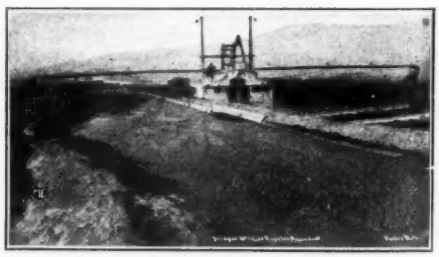
crete lined ditch will carry the water for 40 miles along the base of the Sierra and empty it into the Haiwee Reservoir. The character of the watershed is shown by two photographs taken along the canal. Haiwee basin, with a length of 7 miles, a maximum width of 1¼ miles and a capacity of 20,000,000,000 gallons provides not only for storage, clarification and effective sterilization, but it will regulate the flood waters to a uniform flow of 258,000,000 gallons per day thru the conduit to the southward. From this point on, the conduit is lined and covered with concrete. Its course for many miles lies high along the barren eastern face of the Sierra overlooking the Mojave desert, and here for mile on mile it assumes the form of concrete lined tunnel driven thru the solid rock. At many points the aqueduct zone lies 1,200 feet above the floor of the Mojave and where it has not been practicable to build roads, the materials and machinery necessary for construction have been hoisted into place by means of aerial trams.

Inverted Siphons

Canons and gulches are crossed with inverted steel siphons, varying in diameter from 8½ to 11 feet. The head will range from 50 to 850 feet and the thickness of steel to safely withstand these pressures varies from ¼ inch to 1⅛ inches. Where the head is low and it can be done with safety, strongly reinforced concrete siphons take the place of steel. Photographs show some of these canons, two of them showing steel inverted siphons under construction.

Covered Conduit

About 18 miles from the town of Mojave where the desert assumes a higher elevation, the conduit emerges from the mountains on to the level waste. Here for nearly 70 miles, steam shovels have scooped out an 8 x 12-foot ditch that has been lined and covered with concrete, as shown in one photograph, and which after following the low lying base of the Sierra westward along the Antelope Valley, finds a suitable grade and at Neenach



HYDRAULIC DREDGE *at work in excavation of canal in Owens Valley.*

crosses in the form of a concrete and steel siphon having a diameter of 10 feet and an aggregate length of 21,766 feet. Continuing for 9 miles along the northern base of the Sierra Madre, or, as it is commonly called, the Coast Range, the conduit empties into the Fairmont Reservoir. This basin is designed to regulate the flow thru the Elizabeth tunnel, which, with a length of 5 miles, carries the water to the head of San Francisquito canon on the south side of the range.

Two photographs show the driving of the tunnel and its completed concrete lining. Thru this region of bold and rugged topography the construction is similar to that described in the Sierra excepting that the dimensions are larger to provide for the maximum amount of power development.

Tunnel

The elevation of the south portal of the Elizabeth tunnel is 2,934 feet above sea level; the outlet of the aqueduct 25 miles to the south is at an elevation of 1,485 feet, which provides a fall of more than 1,450 feet for the generation of electrical energy. Here will be built the most powerful of the generating stations, but below the Haiwee Reservoir and between the Upper and Lower San Fernando Reservoirs additional power aggregating 11,500 kilowatts can be developed.

If we now classify the various forms of construction and give more than passing glance to the first two noted, that of tunnels, we are sure to gain a more concrete understanding of the magnitude of the enterprise:

Classification	*Length*
Tunnel	42.69 miles
Power Tunnel	9.23 miles
Open Unlined Canal	21.14 miles
Open Lined Conduit	39.56 miles
Concrete Covered Conduit	97.72 miles
Haiwee By-Pass	1.95 miles
Siphon (Steel and Concrete)	12.06 miles
Flumes	.17 miles
Power Penstock	.44 miles
Other Power Construction	.30 miles
Reservoirs	8.50 miles
Total Length of Aqueduct	233.76 miles

Rapid Construction

Construction, despite all delays, as will be seen from the foregoing, has been carried on at a rate slightly in excess of 50 miles per year. With the exception of one small contract comprising easy classification and less than three per cent. of the work in point of distance, the entire construction has been done by day labor under the city engineers. At this time this longest and in many respects most wonderful water works system in the world is practically ready for operation, altho some finishing touches remain to be made.

From the outset, no expense has been spared to provide the most modern and effective machinery that hand and mind have been able to devise. Dredges, power steam shovels, machinery of varying design and purpose, trainload after trainload of dynamite, all these present-day aids to the construction engineers with their 4,000 men, have resolved the great task into what has been largely an example of perseverance. The unusual speed with which the work has been advanced is due in no small part to the ardor and loyalty of the division engineers and department heads, the friendly rivalry that has been manifested from the start and the esprit de corps of the whole organization.

COMPLETED SECTION OF AQUEDUCT, *two hundred feet above Owens Lake in the background.*

Regulating Reservoirs

The cost of constructing the two San Fernando reservoirs for impounding the waters just below the aqueduct outlet will be defrayed from the revenues of the Water Department. These reservoirs, from 800 to 1,000 feet in elevation above the city, are designed to impound the flow of the aqueduct and to regulate the distribution of water as determined by the seasonal needs of Los Angeles and its environs. By this means such part of the daily normal flow of 258,000,000 gallons as is not needed during the rainy season will be stored and a daily supply in excess of 300,000,000 gallons daily will be made available during the seven months of the dry season when domestic and irrigation requirements are at their maximum.

In very brief form the foregoing de-

scribes the general plan and construction of the aqueduct system. The first of the new year, as was confidently promised in 1905, saw the enterprise practically in its finished form and it will be ready for operation in time for the formal celebration of its dedication to the use of the people of Los Angeles and vicinity, which is now

THE PATH THE STEAM SHOVEL TOOK. *Open conduit being prepared for concrete work.*

planned for May 13, 14 and 15, on a scale of national importance fitting its magnitude.

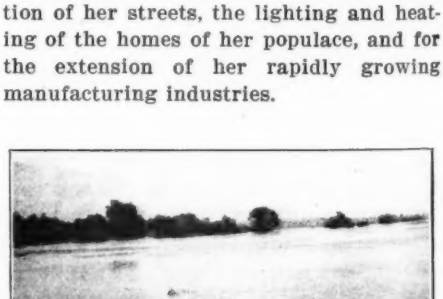
Distributing the Surplus

The task of building the distributing system beyond the limits of the city is one yet to be undertaken and will require three or four years for its final accomplishment. It involves the expenditure of from $4,000,000 to $6,000,000 and the problem not merely of the application of the water to lands desiring it, but the placing of the water on that area which, now suburban, will be gradually included within the city so that the precious fluid shall be gradually diverted from irrigation to the use for which the aqueduct has been designed. At first, the city will take, in addition to the water now being drawn from the Los Angeles river, only one-tenth of the aqueduct supply or approximately 16,000,000 gallons daily. This quantity will be increased gradually as the city continues to expand until that day in the far distant future when the total flow from the long conduit will be required by the city and irrigation from this source will have ceased to exist. In other words the valuable use to which the larger part of the aqueduct supply is to be devoted at first, is simply the economic utilization of the surplus until such time as it is required in the city's mains. Los Angeles of the present has built for the Los Angeles of the future.

Power Development

As has been stated, the construction of the aqueduct arose out of the necessity for a larger water supply and this is of course its primary purpose. The possibilities that lie in the generation of hydro-electric energy, however, from the standpoint of financial gain, make the project, as a water system, of almost secondary importance. By the building of power houses at advantageous points along the aqueduct, a total of 120,000 horse power can be developed.

In 1910 the city voted a bond issue of $3,500,000 for power development and the construction of the first power plant is now underway. This plant is 40 miles from the city and is designed to develop 37,500 horse power. With its transmission lines ending at a sub-station situated at the city limits, this plant will be ready for operation by next July. Other units will be built as fast as there is need for their output. Thus a great dynamic force is made available to be owned and operated by the municipality for the illumination of her streets, the lighting and heating of the homes of her populace, and for the extension of her rapidly growing manufacturing industries.



OWENS RIVER, *at the point where it is diverted to the Los Angeles aqueduct, eleven miles north of Independence, Inyo County, California.*

FAILURE AND SUCCESS IN MUNICIPAL OWNERSHIP

IT is common for superficial observers and readers of official reports to make erroneous statements regarding the condition of the affairs of public service utilities, whether under municipal or private ownership. Not often regarding the latter, however, because few of that class are required by their charters to make such reports or are called upon to make them if provision is made for them or they can for any reason be requested so to do. According to Glenn Marston all plants failing to make such reports should be classed as failures, because, as he says, "in such cases it is a justifiable conclusion to believe that the plant is not sufficiently successful to make a report desirable." However, he applies his criterion only to municipally owned plants, altho he gives no reason, good or bad, for this favoritism, perhaps because practically all private plants are failures according to this definition.

Reports Sometimes Misleading

Financial reports of public service utilities, whether the ordinary annual reports of city officials or employes in charge of them or the statements made for the purpose of promoting the sale of new issues of stocks and bonds on the security of the plants, however owned, are not generally noted for their completeness or accuracy. In the case of the municipally owned plant this is due to lack of knowledge of the principles of bookkeeping or to the character of state or municipal legislation, which divides the business and distributes it among unrelated officers who have little or no official communication with each other. In the case of the privately owned plant this may be due to too great knowledge of the possibilities of bookkeeping and the desire to make as good a case as possible and make the sale of the new securities as easy as possible.

In neither case are the reports evidence of failure or success of the plant. This evidence must be gathered by adding to the information contained in the reports such reliable information as can be gathered from other sources or from a careful study of the plant itself and the results of its operation.

It is easy for one biased in favor of municipal ownership or in favor of private ownership to select such figures or such cases as will bolster up his position, and still present a semblance, at least, of fairness and honesty on the basis of what are presumably the facts, since they are to be found in the published reports. It is seldom an advocate of one or the other system of ownership is so bent upon making a case as to mis-state facts, to garble statements and invent what he cannot find, as the above mentioned Glenn Marston is in a recent pamphlet, entitled "Two Hundred Municipal Ownership Failures," on which his name appears as author. Many of the statements made in the pamphlet have appeared in a monthly devoted to the interests of private ownership of public service utilities whose publisher is the same, so that the claim of authorship seems to be based upon quite as slight grounds as many of the other statements in the publication.

Municipal or Private Ownership

MUNICIPAL ENGINEERING is not a partisan of either municipal or private ownership of public service utilities. Indeed it is disposed to favor such safeguarded semi-private, non-municipal ownership of such plants as the very successful Consumers' Gas Trust Company, which formerly supplied natural gas to Indianapolis, and its equally successful successor in the artificial gas field, the Citizens' Gas Company, which is supplying a high quality of gas at 60 cents to 40 cents a thousand cubic feet and paying the citizens who subscribed the capital to start it 7 per cent. dividends with business

only half developed. Next to this, and only after because of the danger of occasional political manipulation, is the expert control of both public and privately owned plants by state public service commissions, under which the nature of the ownership is comparatively unimportant. This magazine does, however, like to see fair play and cannot let such a publication as the one mentioned pass unchallenged, even if its reputed author does not carry authority and its publisher is a prominent and evidently biased advocate of the side so unfairly presented in it.

Erroneous Reports on Municipal Plants

Information is at hand concerning nearly half the 192 plants included in the list, and indicates a possibility that 20 per cent. of the plants are properly classed as municipal ownership failures, an indication of very low efficiency in the editorial department of the publications under consideration. These failures are in small towns and some of them show equal or greater failures to supply good service and pay good returns under private ownership than they did under municipal ownership. What may happen in improvement of service by a change from private to municipal ownership is shown by the description of the Camden, N. Y., electric light plant, elsewhere in this number of MUNICIPAL ENGINEERING.

There would be too much repetition in showing all the errors of statement in the Marston list, so a few have been selected to show the various types of misrepresentation used and the field covered. Some of the more important cases will be treated in detail in special articles which will appear from time to time.

Alabama

The true story of the North Birmingham water works, on the authority of Maury Nicholson, of the city engineer's department, is as follows: The town of North Birmingham, during its existence as a separate corporation, bonded itself for the construction of a water and light plant. They constructed and put in operation a small pumping station and light plant, which took water from wells in the vicinity of a large, deep limestone quarry and very near to the edge of Village creek. The city of Birmingham took in the corporation of North Birmingham in January, 1910, and inherited this water and light plant by this enlargement of territory. During the spring of 1911, an epidemic of typhoid fever broke out in North Birmingham and the health authorities traced the source of the trouble to this water supply. Upon their report of this fact, the city shut down the pumping plant and connected the North Birmingham pipe system with the pipes of the Birmingham Water Works, buying water from this company by meter measurements and selling to the consumer by flat-rate measurements. This condition of affairs has existed up to the present time. It is now intended shortly to disconnect from the Birmingham Water Works plant and reconnect with the former supply, precaution having been taken to remove the contamination, which is supposed to have come from the quarry or creek, both of which are connected by underground sources with the wells.

Clearly there is no evidence here, nor in the Marston statement, which is quite similar but more brief, that there has been a failure in municipal ownership. On the contrary, the city of Birmingham has evidently pursued the proper course, one which any company would have pursued and is continuing in the same excellent way. There may have been an engineering error in the original location of the wells, or they may have become contaminated by pollution developed later, but these difficulties are not peculiar to municipal ownership; indeed, cities are often better able to cope with them than private companies. The Birmingham Water Works has been obliged to purify its water supplies and to find new sources, and might be cited as evidence of failure of private ownership with equal unfairness and equal lack of good common sense.

California

Ukiah, Cal., is an analogous case. The city electrician, William Bromley, says that in 1908 the old steam plant for generating electricity was closed and cur-

rent was purchased from a hydro-electric transmission line, because the city had outgrown the plant, fuel prices had advanced, and power from the hydro-electric plant could be purchased cheaper than it could be generated by steam. The old machinery was kept in reserve for two years and then sold. Light and power are sold cheaply and extensions, improvements and street lighting are all made and furnished without help from taxes or bonds. Marston's report is similar but is garbled and incomplete. The evidence of eminent success of municipal ownership is overwhelming in this case. There are numerous instances of the same sort in the list, especially in the western states where fuel is high and the new hydro-electric plants can furnish cheap current. Failure to take advantage of such opportunities would be evidence of the stupidity of municipal officials rather than of their competence.

Georgia

In Edgewood, Ga., not only is the electric light plant defunct, but so is the town, it having been absorbed by the city of Atlanta and being now supplied with electric light, etc., by that city, and under no necessity of having a separate plant, as stated by Mayor J. G. Woodward, of Atlanta. No hint of the reason for abandoning the plant is given by Marston. This item is again typical of a number of those in the list.

Illinois

Marston reports Moline, Ill., as able to save over $35 per lamp per year by selling a $25,000 plant for $7,900 and making a contract for street lights. Mayor Martin R. Carlson, on the contrary, says that the city of Moline never owned its electric light plant. It has always contracted for street lighting and is now paying $60 a year each for 340 1,000-c.p. arc lights. Possibly Mr. Marston has made a mistake this time and is trying to state the case of East Moline. But he is not much better off under this supposition, for that city, like Ukiah, Cal., is now purchasing electric current from the new hydro-electric power plant and will probably make a considerable saving from the former cost of operating by steam power; another evidence of good judgment in city officials and success in municipal ownership. Arc lamps now cost East Moline $65 a year each and metallic incandescent lamps $21 each.

Iowa

Iowa cities have more or less complaint to make of incompetence, lack of public spirit, or dishonesty in public officials and Marston comes nearer stating the facts in this state than in any other, except possibly Ohio. But even here he selects his facts to suit his theory. Thus he quotes the Dubuque reports on water plant for 1907. Mayor M. O. Lyons states that the report was undoubtedly true up to 1907, at which time the old board of water works trustees was superseded and the superintendent found guilty of mismanagement and embezzlement. No enterprise, either municipal or private, could possibly have been other than a failure with the methods then employed. Since that time a new water commission has introduced more business-like methods and the plant is now able to pay out of the earnings from its private business a contribution to the extinguishment of the bonded indebtedness of the plant and to take care of the depreciation. The major part of the bonds and interest are paid from the proceeds of a special tax which are equal in amount to the value of the fire protection service rendered to the city by the plant.

Kansas

The Ottawa, Kan., municipal light plant is included in Marston's list of municipal ownership failures because "the operating and maintenance expenses of the water and light business have not been separated." Such judgment as this is sufficient to condemn the author's judgment on any proposition that he may make, especially since the combined water and light plant pays all possible charges against it, including operation and maintenance, interest on bonds, new construction and equipment equivalent to an ample depreciation charge, $2,000 of maturing bonds, and $3,000 of bonds purchased for the reserve fund.

Kentucky

Marston's statement regarding Henderson, Ky., is that "in April, 1912, the city abandoned its expensive generating station and made a contract for electric power with the Henderson Traction Company at a much lower rate than the cost of operating its own plant." Mayor W. J. Thompson reports that this statement is "twisted so that south is changed to north. The facts are that in April, 1912, the traction company and an interurban line running from here to Evansville abandoned their power station, and contracted with the city to furnish power for them, on which contract we are making a handsome profit. I wrote to Mr. Glenn Marston in regard to his incorrect report and he agreed to correct this false statement and said that the publisher of *Public Service* would make the same correction. If you see the correction could you send it to me?"

Louisiana

Mail sent to Brighton, La., whose gas plant is reported by Marston to be a failure, is returned stamped "No such postoffice in state named."

Massachusetts

The manager of the North Attleboro, Mass., electric light station is reported by Marston to have recommended that the city abandon its generating station and purchase power from a nearby private company, as it is very costly to run the antiquated station of the city. The manager, William Plattner, strongly resents this erroneous statement, showing by a list of equipment that all of his electric equipment and nearly half his engine equipment was installed in 1907 and is modern in every respect. He further says: "The reason I recommended the purchase of current was on account of the anticipated increase in the power business. Our present business has taxed our station to the full capacity, and we secured a very attractive low rate which we considered greater economy than to install additional equipment. We are purchasing a portion of our current at a price lower than any other municipality in Massachusetts, considering the business we do. We operate our plant during the peak load, which is about five hours, and the balance is purchased. This is a business proposition that any private corporation would have done if similarly situated. I can name you several large private corporations of electric light and power that have practically shut down their plants or a portion of same within the last few years and purchase their current from other sources, not because a plant is antiquated but conditions of manufacture are such that a large transmission or private corporation doing extensive business was in a position to take on a smaller proposition at a more attractive price than they were able to manufacture it themselves." He cites such large companies as The Edison Electric Illuminating Company, of Boston, as serving surrounding suburbs cheaper than local plants could do it. Apparently Mr. Plattner's plant is managed efficiently and Marston is again guilty of misrepresentation, of favoritism and of bad judgment, either in classing the plant as a failure or in failure to class the private plants taking the same steps as failures likewise, for if one is a failure they are all failures by the same token and cannot be separated into municipal and private ownership classes of failure. This sort of failure is quite similar to those of the West where small plants save money by buying current of large hydro-electric plants.

Michigan

Marston's statement that the municipal electric plant of Elk Rapids, Mich., did not pay and was sold in 1908 to the Elk Electric Company, is denied by A. G. Maxwell, village clerk, who says that the town never owned a light plant. The successive owners of the plant from which the town purchases street lighting have been W. E. Donnelly, Elk Rapids Electric Co., and Elk Electric Company, demonstrating wilful misstatement or equally inexcusable carelessness in ascertaining the facts.

Minnesota

The statements about the gas plant at Duluth, Minn., are on a par with those regarding purchases of electric current

from outside sources, it being cheaper to purchase the gas which is a by-product of the coke ovens of the Zenith Furnace Company than to manufacture gas by the usual processes, so that this is an example of good management rather than of failure.

Mississippi

The city attorney of Pontotoc, Miss., reports that "municipal ownership was a failure, due to poor management. However private ownership was a failure, due to the same cause, up to September, 1912, when the plant got into present hands."

Missouri

Marceline, Mo., is another victim of Marston's misrepresentations, whether thru carelessness or design, for he says the "town had one of the first municipal electric plants but it did not pay. The city operated it until it burned. Sentiment was so strong against municipal ownership that the plant was not rebuilt," whereas Mayor E. S. Haldeman says: "Our plant did not burn. We are still operating our plant and meeting our regular payments on plant and meet our monthly bills promptly and get our discounts. We have paid off part of our bonded debt sixteen years in advance and have never missed an interest date and have money on hands now."

New York

Returns from three of the six New York plants in Marston's list have been received and show equally flagrant misrepresentations, the following from F. D. DuBois, superintendent of the Mohawk municipal commission, being a fair sample: "The statement concerning the Mohawk municipal light plant is false in every particular. It has not been sold or leased to a private company, and further, out of $6,300 receipts at rates of from 6 to 10 cents per k.w., the reports show a net income for year of $1,879.44."

North Carolina

High Point, N. C., is another "failure" similar to those in California, being able to purchase street lighting and current for distribution to commercial customers at less cost from a hydro-electric company than the city could make it, low enough, in fact, to be able to charge half the retail rates of private corporations in surrounding towns.

Ohio

Marston's report regarding Willoughby, O., is partially correct, but instead of a franchise being granted to a traction company for furnishing electric light, Mayor Sidney J. Wilson reports that they "no longer generate the electricity, but buy it wholesale from electric railroad line and retail it over our own system of wires."

Pennsylvania

The secretary of the borough of Grove City, Pa., L. L. McKay, states that there was a deficit in the financial condition of the electric light plant in 1909, but the plant was "put in in 1908 and would hardly be a paying investment immediately, but our auditor's report of January, 1912, gave it $1,300 over all expenses, and that of January, 1913, $1,720.90 cash gain," so that Marston was hardly fair in suppressing all the facts but the one of a deficit in one year's operations.

Tennessee

Lebanon, Tenn., is another instance of good judgment in purchasing current wholesale and selling it retail of which so many have already been mentioned.

Texas

El Paso, Tex., is reported by Marston to have put into effect a rate of 20 cents a thousand gallons when it purchased the water works and to have been obliged to increase to 30 cents. Whether this be true or not, Mayor C. E. Kelly reports that a reduction of 50 per cent. in rates went into effect March 1. Mr. Marston seems in this case, as in that of Grove City, Pa., to have been a little too prompt in his condemnation of municipal management, for, given time to get into full operation, both cities have turned losses into gains.

Washington

Ballard, Wash., is another example of a small city absorbed by a larger city, Seattle, and now served by that city. Both

Seattle and Tacoma are most inexcusably misrepresented in Marston's list, but their plants are important and interesting enough to require treatment in special articles now under preparation.

Wisconsin

Failure to furnish fire pressure at a test for 42 minutes after signal was given is given as the reason for including the Madison, Wis., water works in Marston's list of water works failures. Unfortunately this sort of failure is not restricted to municipal plants, and Madison was no worse off than many cities under private ownership, so that the one may be offset by the others. Actually the occurrence did demonstrate a lack of cooperation of water works employes or a lack of discipline, which might be considered a little more likely to occur in a municipal than a private plant, but Mr. Marston seems to miss this point and lays the failure to lack of water rather than to the neglect to repair an important valve.

The foregoing examples have been limited to one in each state from which reports have been received. Others will be given from time to time as opportunity offers.

License Fees Charged by City of Buffalo

Some of the license fees charged by the city of Buffalo are as follows: Annual fees—Auctioneers, $50.00; bakers and confectioners, $3.00 to $10.00; billiards and pool, $5.00 per table; bowling alleys, $5.00 each; butchers, $15.00; employment agencies, $25.00; fish markets, $10.00; junk dealers, hand wagon, $2.00; one-horse wagon, $3.00; wholesale, $25.00; milk, per wagon, $2.00; wholesale oil, gasoline, paint and dealers in other inflammable and volatile liquids, $20.00; retails dealers storing inflammable oils, $1.00; peddlers, $25.00 to $100.00; pawnbrokers, $50.00; dancing schools, $25.00; second-hand dealers, $10.00; vehicles, one-horse, $1.00; two-horse, $5.00; slaughter houses, $25.00. Theaters, moving picture shows and amusement parks are taxed $100.00 per annum; circuses, $75.00 to $200.00 per day. During 1911, 18,111 licenses were issued, including dog licenses, at $1.00 and $2.00, and horse licenses at $1.00 per horse.

ROAD CONSTRUCTION IN MICHIGAN

By Frank F. Rogers, C. E., Deputy Highway Commissioner.

On Michigan state reward roads the law requires that the steepest incline shall not exceed six per cent. On macadam roads it should be 3 per cent or less where cost is not burdensome. Long stretches of unbroken grade are objectionable, however, being more expensive to maintain than roads that are slightly undulating. It is estimated that horses can exert one-tenth of their weight as a tractive force on continuous work, but they can readily exert themselves for brief periods of time up to three, or even four times their daily average, so that short stretches of undulating grades, none of which exceed six per cent. can not materially lessen the capacity of a macadam road.

Cost of Grading

Where old roads have been regraded to make state reward roads, the cost has usually run from $200 to $500 a mile, $350 being a fair average. Some hilly roads have been graded at costs greater than $2,000 a mile. No tool is so efficient as the road grader in skillful hands, although the plow and harrow are frequently required to put the road in shape for using the grader to advantage. On turnpikes with deep ditches, the flat, or Doan scraper, is an excellent tool. The drag scraper is good for hauls up to 150 feet. Between that distance and 700 feet, wheel scrapers are best. For hauls longer than 700 feet it is cheaper to use wagons.

Drainage

In most soils sufficient drainage is provided by side ditches just large enough to provide for the free flow of such water as naturally comes to the road. In clay soils the bottoms of the ditches should not be less than two feet below the crown of the road, unless supplemented by tile drains. Especial pains must be taken to provide all road ditches with free outlets having sufficient fall to remove all water to some distance from the road. Tile drains are needed in all springy or water bearing soils. It is usually advisable to cover the tiles six inches or more with gravel, cinders, or broken stone.

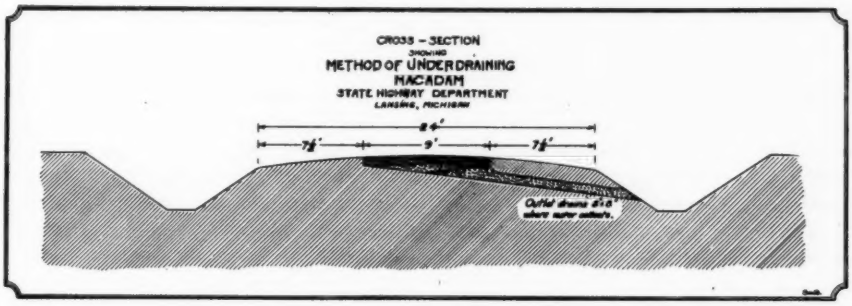


Fig. I.

In clay soils trenches should be cut thru the shoulders described in the next paragraph, thus making outlets into the side ditches for water that may collect in the stone bed during construction, and afterwards until the surface becomes hard and water-proof. Such trenches should be 8 inches or 10 inches in width and slightly deeper than the stone bed. (See Fig. I.) These drains should be placed on both sides, in pairs, at every low point in the grade and, in very retentive soils, at intervals of not more than 100 feet.

FIG. II. BROKEN STONE *filled in between shoulders, with roller at work.*

On grades above 4 per cent trouble is caused by the washing out of the side gutters. This can be effectively prevented by paving the gutters with cobblestones or concrete or by spreading evenly over the bottoms of the gutters a three or four-inch layer of crushed stone, preferably that under 1½ inches in size. Coarse gravel has been used for this purpose with good results.

Macadam Bed and Shoulders

The macadam bed should be formed by placing shoulders of firm earth, or other suitable material, on each side of the center line and far enough apart to retain the proposed width of macadam, which, on Michigan state reward roads, must be at least 9 feet wide and not less than 6 inches deep after compacting. Any greater width and depth that the builders desire to make would be approved by the state but would not, under present laws, entitle the road to any greater bounty.

The shoulders are formed by scraping earth from the center to each side with a road grader, or if the old grade is low, by bringing up earth from the sides with the grader, provided it can be spared from the gutters or ditches. A common mistake is to excavate unnecessarily large ditches along the roadside at the foot of a fill, for the purpose of forming the embankment, which should never be tolerated in highway work. On sandy or mucky ground, any of the clayey or loamy soils are suitable for shoulders, but a good packing gravel is better. A double layer of sods about one foot in width, placed grass side down and backed up with sand or other light soil, makes a very satisfactory shoulder.

The shoulders thus formed should extend to the side ditches or gutters with the same grade and curvature as required for the finished road, viz: an average rise of one inch for each foot of distance from the inner edge of the ditches or gutters to the center line of the road. Thus, a twenty foot roadway would have a 10-inch crown and a 24-foot roadway a 12-inch crown. With this kind of road section, the drop at a point 5 feet out from the center line should not exceed 3 inches.

Hand trimming with mattocks and shovels will bring the macadam bed to the exact sub-grade, giving it the same width and curvature as required for the finished road. Due allowance must be made for settlement of the sub-grade by rolling. Crushed stone is far too expensive a material to fill hollows with, for they can be filled with earth from the shoulders at less than one-tenth the cost of broken

stone, and every high point protruding into the macadam means a defective place in the finished road and hastens the day when repairs will be necessary.

Suitable Stone for Macadam

In Michigan the most used road stones, in the order of their values are: trap, cobblestones or field boulders, and limestone. The former is found only in the Upper Peninsula, and, thus far, has not been used on country roads except in the counties of Dickinson, Gogebic, Houghton, Keweenaw and Marquette, altho some has been shipped to Detroit for park roads. A large part of the limestone macadam used on the west side of the state is shipped across Lake Michigan from Wisconsin.

Cobblestones consist of a variety of rocks from the toughest trap thru the various granites and limestones to sandstones of no value to the roadbuilder. They are usually crushed with portable machines placed near where they are to be used.

Crushing Cobbles

There is no difficulty in crushing cobblestones with portable crushers, where the best types of steel crushers are employed. Traction engines rated at from 15 to 20 h. p. will easily drive any of these crushers. It is not economy to use a steam roller for this purpose. It is needed for rolling every day the crusher is running, and is too expensive a machine to wear out for power purposes.

Purchase cobblestones by weight. From 13,500 pounds to 14,000 pounds are required for a cord, which will make 5 cubic yards of crushed rock measured in the different grades.

The cost of crushing cobblestone, including labor, fuel, oil and small repairs, can be kept down to 30 cents per cubic yard. Repairs, depreciation, interest, etc., would add another 20 cents.

The rotary screen has a drum not less than 9 feet long and 30 inches in diameter, perforated to give three required sizes of metal. When crushing cobbles, the writer prefers ¾-inch, 2-inch and 3-inch holes. If the stone is so soft that too large a percentage of screenings passes thru the ¾-inch holes, a ½-inch mesh wire screen should be placed around the plate screen and bolted to it, forming a jacket. If too much dust is produced, as might be the case with limestone, a ¼-inch mesh wire screen attached as above described, may be used as a dust jacket and the dust spouted into a special pocket.

The three grades of stone are discharged into separate pockets of the storage bins from which they are drawn by gravity directly into the wagons in the order they are to be placed on the road. The fine stone is commonly called "screenings" or "binder," but the grades are usually designated by the numbers 1, 2 and 3—number 3 being the largest size.

Limestone, which is used for building most of the macadam roads in Michigan, is usually bought from the large commercial crushing plants, broken to sizes and delivered within teaming distance of the road.

First Course of Macadam

On the prepared bed the first course of No. 3 stone is laid to make the depth not less than 3½ inches after rolling, say 4½ inches loose measure. If a harder and more expensive stone is to be used for the surface, the bottom layer may be increased to 5 inches loose measure and the top layer thinned accordingly.

The different sizes of stone must be well mixed. Alternate patches of large and small-sized stones will not make a road surface that wears evenly. Unless automatic spreading wagons are used, it is best to make three or four dumps of each load, so that the least possible amount of handling with rakes and shovels will be required. In no case should this layer be put on a muddy bed. After the stone has been spread it should be rolled two or three times with a power roller weighing about 10 tons and then covered with No. 1 stone (screenings) to a uniform depth of about ¾-inch and rerolled. The rolling should commence on the edge of the stone with about half of the outer rear wheel of the roller lapping on the earth shoulder, and gradually lapping towards the center as the rolling continues. As soon as one-half of the roadway is thus rolled the roller should be run off the stone and started on the other side, finishing at the center. Any other method will soon destroy the crown of the road. (See Fig. II.)

The amount of screenings used should be somewhat less than enough to fill the voids in the No. 3 stone. Water may be applied in advance of the roller when working on sandy soils but not until the roller has passed a few times over the dry screenings. But water should be used sparingly, if at all, on the No. 3 stone when building over clay and loamy soils on account of the tendency to form mud on the sub-grade, into which the stone is driven by the roller. The rolling of this course must continue until the binder is all worked into the crevices of the larger stones and until the stones cease to sink or creep beneath the roller. If hollows develop by reason of this rolling, they should be filled with suitable stones of the same grade and not with screenings.

If commercial limestone is used, it is better to use stone that will range from 1½ to 3 inches in greatest dimension, and to use the same grade of stone for both the bottom and top layers, but it is very important that the stone shall be evenly mixed when spread upon the road. When limestone screenings are used for binder, only those from which the dust has been removed should be accepted. Plenty of dust for cementing purposes will be formed under the roller, and, when the road is once consolidated, the less dust on the surface the better. This dust is a nuisance in dry weather and makes a disagreeable mud when the weather is wet.

Before placing the first layer of stone on dry mealy sand sub-grades, it is often necessary to spread a thin layer of marsh hay, rotten straw or some other vegetable fibre to prevent a large part of the No. 3 stone being driven into the sand so deeply that it is of little value except as a sub-base. An extra layer of stone rolled into the sub-grade makes a foundation equally as good or better than the materials above mentioned, but the cost of the stone usually makes this latter method so expensive that it is prohibitive.

Top Course of Macadam

After the first course of macadam has been applied and bonded and rolled as above described another layer of stone must be added and of such uniform thickness as to make the total compacted depth of the road at least 6 inches, if it is expected to draw state reward. The stone used in this layer will be that known as No. 2, which passed thru the 2-inch perforations of the crusher screen and was caught in the second pocket of the elevator bins. However, should limestone from

FIG. III. PORTABLE STONE CRUSHER, *screen and bins. Cobble stone pile on right, wagon loading crushed stone on left.*

the commercial quarries be used, it is better to purchase stones ranging from 1½ to 3 inches in size, as already specified for the first course of macadam. Stones of this size wear much better, are not easily dislodged and left in a loose condition on the road bed, nor so easily picked up by the mud that adheres to the wheels of vehicles. Some engineers have placed the No. 2 limestone in the bottom layer and the No. 3 limestone in the top layer, and the results are reported to be very satisfactory.

When the stone for the top layer has been spread as above described, it shall be rolled until smooth with a 10-ton power roller, after which screenings (No. 1 stone) will again be applied to the uniform depth of about ¾ of an inch and rolled a few times over before wetting. From this on, water must be applied freely from a horse sprinkler and the rolling continued until the water flushes to the surface. As the rolling progresses, the screenings will have to be added until all the voids are filled and a very thin coating of screenings covers the surface.

In no case should the screenings be dumped in piles on the loose stones. When this is done, the screenings are never evenly spread and many of them are wasted. Too many screenings are detrimental to the road as well as a total waste of the most expensive part of the road covering, particularly if made from hard stone. Unless the screenings can be spread evenly with automatic spreading wagons, it is best to place them on the shoulders along the sides of the roadway and then spread them carefully by hand. Pains must be taken to apply the screenings evenly mixed. Casting crosswise of the road with shovels invariably places the chips on the far side and the dust on the side where the spreader stands. This can be overcome by casting lengthwise of the road with a swinging motion of the shovel.

In the final rolling the whole surface of the roadway, including the shoulders, must be covered. Hollows that may have developed in the shoulders must be filled, and high places leveled down and the process of leveling and rolling continued until the whole road grade from gutter to gutter is so firm and smooth that water will flow to the side drains without obstruction. Fig. IV shows both layers of stone and a steam roller at work.

After rolling the road should be kept closed to traffic until the surplus water has dried out, taken a "set," and become so hard that it will have a metallic ring when driving over it and small pieces of rock will crush under a heavy load before penetrating the surface.

The amount of rolling and water required are much more than the inexperienced road builder will expect. About 900 barrels of water will be required for each mile of 9-foot macadam roadway, which is no small item of cost if the water is not very handy. If the water is not used to the best advantage more will be required.

A steam roller cannot compact more than 50 to 75 cubic yards of crushed rock daily. That is about the output of the ordinary portable rock crusher and means that from 20 to 30 days of steady rolling are required to consolidate properly a mile of state reward macadam road.

Cost of Macadam Roads

The average cost of macadam roads in Michigan is running slightly less than $4,500 a mile. Some roads have been built for less than $3,000, while others have cost more than $8,000 per mile. The higher costs usually mean that the grading cost was high, or that the width of macadam was made greater than 9 feet.

As the grading cost, the material cost and the distance the material has to be hauled are the three items subject to greatest variation, a model estimate will be given on which the above items will be taken at fair assumed values, so that they can be changed by anyone desiring to make other estimates that will fit different conditions and places where these values have been determined.

First, we shall assume that crushed limestone is to be purchased from a commercial quarry and delivered f. o. b. cars at some siding within a wagon haul of the proposed road. The estimates are as follows:

FIG. IV. PLACING BROKEN STONE. *Foreground has received first broken stone. Farther back second layer is placed, and roller is at work on it.*

Grading, per mile	$ 350.00
1,200 cu. yds. crushed stone, 1½ to 2 in. in size, at $1.40	1,680.00
300 cu. yds. screenings with dust out, at $1.40	420.00
Loading and hauling 1,500 cu. yds. stone one mile, at $ .45	675.00
Spreading same, $ .05	75.00
Sprinkling and rolling, 25 days at $15.00	375.00
Superintendence and contingencies	200.00
Total	$3,775.00

If crushed cobblestones are used, 300 cords to the mile will be required. These should crush into 1,500 cubic yards, measured in the different grades. The crusher should be set but once for each mile of road and as near the center of the mile as is practicable. In this case, the stone cost at $4.00 per cord would be as follows:

300 cords cobbles at $4.00	$1,200.00
Crushing 1,500 cu. yds. at 50c	750.00
Hauling 1,500 cu. yds. of stone to to the road (no shoveling into wagons required) at 30c	450.00
Total	$2,400.00

This shows a saving on stone delivered to the road of $375.00 and we may assume that the other items will remain the same. In such a case, one would be justified in paying $5.25 per cord for cobbles delivered at the crusher, as compared with commercial stone at $1.40 per cubic yard on cars one mile from the road.

The following cost is taken from a Michigan state reward road built in Golden Township, Oceana County, by Fred Urtel, Township Highway Commissioner:

Grading	$ 237.40
301½ cords cobbles at $4.00	1,206.00
Crushing same	547.87
Hauling stone from the crusher and spreading on the road	500.20
Rolling and sprinkling	208.12
Superintendence and plans	162.12
Total	$2,861.71

The above cost is very low and does not include profits to any one, nor rental or depreciation for the machinery used. It is all owned by the township and the work was performed by day labor under the direction of the township commissioner. It does include, however, the cost of moving the crusher from a former location and erecting it on the job, as well as fuel and oil and other incidental expenses. It might be further said that the finished road was a credit to its builders.

Fig. III shows the crusher at work on the above road, with a portable bin on trucks. Note what is said above about using the roller for power purposes.

MUNICIPAL LIGHTING PLANT OPERATED BY OIL ENGINE

By L. F. Phelps, Clerk of Camden Light Commission

THE municipal electric plant in Camden, N. Y., was constructed in 1905 and 1906 after several years of more or less unsatisfactory experience with private ownership of a lighting system which in itself was neither reliable nor efficient. The power house is of brick construction, attractive in appearance, and designed with the combined idea of convenience and utility. The engine room occupies the main and front portion of the building while in the rear are located the shop and office, both of which, however, extend to but one-half of the height of the building, thus leaving a balcony for storage purposes above them and facing the power house proper. There are two basements separated by fireproof walls; one used as a furnace cellar while in the other are located the two Ingersoll-Rand air compressors which form part of the Diesel motive equipment.

Oil Engines

The original power installation consisted of one vertical type American Diesel oil engine of 170 h. p., direct connected to one 130 k. w. Westinghouse a. c. generator. The commercial lighting circuit is divided into two trunk lines, each supplying one-half of the town. The street lighting is accomplished by means of 74 a. c. Westinghouse enclosed series arcs, giving 2,000 c. p. and located at moderate distances, practically on every corner. It is a general opinion that there is no better lighted town in New York State, and few that are its equal. In 1911 the business had increased to such a degree that more power was imperative, and a proposition brought before the people for the required addition was almost unanimously adopted. Accordingly, a second Diesel engine of 225 h. p., made by the Busch-Sulzer Bros. Diesel Engine Co. of St. Louis, Mo., was installed and the electrical machinery, consisting of a 160-k. w., a. c. generator was furnished by the Fort Wayne Electric Works. The plant is now well situated to furnish all light required and give continuous service to all desiring it.

The Diesel oil engine will produce electricity at about one-half cent per k. w.-hour, including all operating expenses, but no fixed charges. One hundred and fifty horse power can be produced for one hour on seven or eight gallons of fuel oil.

Rates

At present there are 270 consumers connected with the commercial branch, all on a meter basis. Current is charged for at the rate of 10 cents per k. w., with discount of 20 per cent. if paid before the tenth of the month following that for which the bill is rendered. The municipality furnishes meters with the understanding that in so doing no bill will be rendered for less than $1.00 a month. The option of buying a meter from the plant, at a reasonable figure, is given all customers, in which case the minimum charge becomes 50 cents per month, with regular terms as in the first case.

The street lights, of whose type and size mention has before been made, are charged to the city at the rate of $50.00 a lamp per year. This method is the same as might be conducted with an individual lighting corporation with the important exception that in the latter case the sum of $3,700 is paid annually for light exclusively, while in successful municipal ownership this amount is virtually retiring interest charges and bonded indebtedness and thus eventually providing for street lighting at no cost to the taxpayers, who are the actual owners of the lighting business.

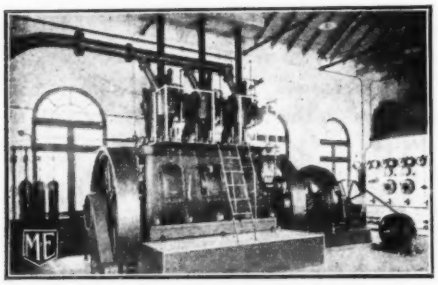
Cost of Plant

The system was first constructed at a cost of $40,000, and during the past year

there has been added equipment to the amount of approximately $19,000, of which the following is a summary:

Engine and auxiliaries, including purchase price paid to Busch-Sulzer Bros. Diesel Engine Co., freight, belts, etc.	$14,700.00
Electrical apparatus, including generator, exciter, motor, switchboard panel, all from Fort Wayne Electric Co.	3,200.00
Concrete work, foundations, engine bed, etc.	325.00
Labor of installation	600.00
Miscellaneous expenses	175.00
Total	$19,000.00

Of this amount, $18,000 is covered by a bond issue against the village of Camden and the balance of $1,000 consisted of an appropriation from the sinking fund of the plant.



225 H. P. DIESEL OIL ENGINE *direct connected to Fort Wayne Electric Works* 160 *w. a. c. generator.*

Operating Figures

The following figures taken from the annual report of the Camden Light Commission give an accurate idea of the operating side of the institution and show the system to be on a sound financial basis:

Revenues	
Commercial lighting	$ 5,741.58
Street lighting, unpaid from 1911	616.66
Street lighting, 1912	2,466.67
Wiring, etc.	373.28
Total	$ 9,198.19
Balance on hand March 1, 1911	3,280.93
	$12,479.12

Disbursements	
Salaries and wages	$ 2,431.94
Fuel oil	1,179.57
Lubricants	312.61
Street lighting supplies	135.93
Misc. operating expenses	164.56
Repairs of all equipment	233.08
Office expenses	85.73
Total maintenance and operating expenditures	$ 4,543.42
Added to equipment of plant	434.36
Bonds retired	1,600.00
Interest charges	1,380.00
Credit to sinking fund	2,500.00
Balance on hand March 1, 1912	2,021.34
	$12,479.12

Balance on hand March 1, 1912	$ 2,021.34
Due for street lighting	1,223.00
Other outstanding accounts	162.15
	$ 3,406.49

Cost of Oil

These figures are necessarily condensed and explanatory details are omitted. However, the essential details are given and can easily be understood. The cost of fuel oil which is used in the engines varies from year to year. It has been purchased as low as 2.9 cents per gallon delivered, but at the present writing the quotation is unusually high. It is indeed difficult for the average consumer to comprehend exactly why this should be, but the fact remains that the increase has been rapid for the past six months and the price is now nearly double what it was a year ago. Users of oil engines generally are anxiously awaiting a reduction in cost, but whether they and others will receive that for which they are wishing is doubtful.

Favor Municipal Ownership

The plant at Camden is in first-class condition, both from mechanical and financial standpoints, and the little pessimism which was rife for a few years after its establishment has gradually disappeared under a sound business management by a commission of practical business men. Camden is more than strong for public ownership of its utilities and now owns and operates both lighting and water systems, each of which is a well-paying proposition and a strong plea for municipal control of the general necessities.

WATER SYSTEM FOR UPPER WILLAMETTE VALLEY, OREGON.

By Louis C. Kelsey, M. Am. Soc., C. E.,
Consulting Engineer to Oregon State Board of Health.

Louis C. Kelsey, M. Am. Soc., C. E., the author of the cooperative plan for supplying water and power to a string of cities and institutions has been a prominent municipal and hydraulic engineer in the Intermountain country and on the West Coast for some twenty-five years. Eighteen years of this time was spent in the department of public works at Salt Lake City, Utah, first as assistant city engineer and later as city engineer. Some years ago he removed to Portland, Oregon, and engaged in private practice, serving for some years also in his present position of consulting engineer to the State Board of Health of Oregon.

He constructed some millions of dollars worth of pavements for Salt Lake City and for Hillsboro, Oregon. He designed and supervised large extensions of outlet sewers and pumping plant for the same for Salt Lake, including a surface drainage system for the lower part of the city; sanitary sewers for Blackfoot, St. Anthony, and Burley, Idaho, and Linton, Ore.; sewers with disposal plants for Gooding and Hailey, Ida., Newport, Hillsboro, Newburg, and LaGrande, Ore., Sparks, Winnemucca and Las Vegas, Nev., Elma, Wash.; and storm sewers for three of these cities. His work for Idaho Falls, Ida. included hydro-electric power and lighting and water-works pumping plants, street and sidewalk construction and surface drainage.

The present session of the Oregon legislature is considering the passage of laws which will make it possible to carry out the plan outlined by Mr. Kelsey in this article.

SINCE December, 1911, I have been making reconnoissances, investigations and preliminary surveys for determining the most desirable supply of wholesome water in sufficient quantity from a lake in the Cascade Mountains for the present and future needs of the cities and towns in the upper Willamette Valley, Oregon.

LOUIS C. KELSEY.

This project is of utmost importance to many municipalities in that section and my opinion is that Clear Lake, 76 miles east of Eugene, Ore., should be tapped and its water brought to the valley for the supplying of a dozen or more cities and state institutions, as far north as Salem, 75 miles from Eugene.

That an adequate supply of water of pure quality is essential to the welfare and growth of the municipalities in the upper Willamette Valley, is an accepted fact. Independent of the important consideration of promoting the public health, every community should have sufficient water supply under pressure for both present and future needs for fire protection, flushing sewers and paved streets, lawn and street sprinkling, and for all domestic and municipal purposes.

Need for Pure Water

In the year 1906 and again in 1910 the people of Eugene were afflicted with an epidemic of typhoid fever, and in 1909 a similar and equally serious epidemic, also traceable to the water supply, was in Salem, but only temporary remedial measures have been adopted in these cities

looking toward more acceptable conditions of water supply. The City of Eugene has installed a mechanical filtration plant and is also using hypochlorite of lime to minimize the impurities of the river water. At Salem the water company uses the same chemical agency to purify the river water after it passes thru crude sand filters. The adoption of these means has lessened to an appreciable degree the hazard to public health thru using water, partly purified, for domestic purposes.

Incidentally, attention has been drawn at this time by the public press to the breaking out of an epidemic of typhoid fever at Oregon City. While the source of the epidemic has not yet been definitely traced, it is significant that Oregon City take its water supply from the Willamette River, nearly 40 miles below Salem, thru a mechanical filtration plant which has been praised for its efficiency.

Purity and Volume of Clear Lake

Clear Lake empties into the McKenzie River, which in turn flows into the Willamette near the Irving, and is the main feeder of that stream. Careful analysis of its water for the health board shows less than 100 organisms to the cubic centimeter, and no colon bacilli, the harbinger of typhoid. Its water is therefore classed as "exceptionally pure."

Clear Lake's water is clear as crystal at all times and as cold as ice. No sediment has been known to appear in this water, even at the outlet, and because of the same conditions existing down as far as the proposed point of diversion it would be unnecessary to provide for settling basins or reservoirs other than distributing reservoirs at or near each city.

The length of the great pipe would be 150 miles, and it would vary in diameter from 44 to 35 inches. In a single day it would bring down from the mountain lake 30,000 gallons of the purest water, enough to supply a population of 200,000 persons and enough, it is further estimated, for all the needs of the upper Willamette valley for 25 years to come.

This is a water supply greater than was brought to Portland by its first Bull Run pipe line, constructed in 1893, which served the city until the laying of the second line two years ago. This first line brought only 24,000 gallons a day to the city.

If the whole available water supply of the lake were needed, it could furnish all the water that 1,500,000 persons would need.

Municipalities and Institutions to Be Served

The twelve valley municipalities which the proposed pipe line would touch are Sprinfield, Eugene, Creswell, Junction City, Halsey, Coburg, Harrisburg, Albany, Brownsville, Jefferson, Independence, Turner and Salem. In addition to these the small towns of Irving, Tangent, Marion and Shedd are among those whose growth will soon require a public water supply.

The existing means of water supply are as follows:

Municipalities and Institutions.	Source of Water Supply.	Method of Purification.	Means of Delivery.
Albany	Canal from Santiam River	Filtration	Pumping
Brownville	Callapooya River	None	Gravity
Coburg	Shallow well	None	Pumping
Eugene	Willamette River	Hc. of lime filtration	Pumping
Harrisburg	Well near Willamette River	None	Pumping
Independence	Wells near Willamette River	None	Pumping
Jefferson	Mill race from Santiam River	None	Pumping
Junction City	Well near Willamette River	None	Pumping
Salem	Gravel bar in Willamette River	Hc. of lime sand filtration	Pumping
Springfield	Mill race from Willamette River	Filtration	Pumping
Capitol	Salem Water Company's service	Filtered	Pumping
Insane Asylum	Drinking water from well	None	Pumping
	From Mill Creek for other uses	None	Pumping
Inst. for Imbeciles	Shallow wells	None	Pumping
Tuberculosis Sanitarium	Spring and well	Filtered	Pumping
Inst. for the Blind	Salem Water Company's service	None	Pumping
Penitentiary	Wells on penitentiary grounds	None	Gravity
Reform School	Baker Spring; also Mill Creek	Filtered	Pumping
School for Deaf Mutes	Salem Water Company's service	None	Pumping
Fair Grounds	Well on grounds; also Mill Creek	Filtered	Pumping
University of Oregon	Eugene's city water service	None	Pumping
U. S. Indian School	Well on school grounds		

Cost of Construction

The matter of probable cost of constructing the proposed Clear Lake water supply system has been carefully considered with reference to approximate quantities and classes of materials and labor and their cost, and I have determined the following as conservative estimates for a complete main-supply pipe line from Blue River, the proposed place of diverting Clear Lake water, to Salem, a distance of 116 miles:

If continuous wooden-stave pipe construction	$3,900,000
If steel pipe construction	4,900,000
If reinforced concrete pipe construction 25 miles at upper end and remainder of distance to Salem wooden pipe	4,000,000
If reinforced concrete pipe construction 25 miles at upper end and remainder of distance to Salem steel pipe	4,800,000

To construct the main supply pipe line of cast iron would involve a cost amounting to an almost prohibitive sum. The other classes of construction upon which estimates are based are suitable, and as experience has shown, either wood or steel pipe, or reinforced concrete pipe at the upper end, would be durable and satisfactory construction.

Sources of Revenue

Of course, each municipality composing the district to be supplied with Clear Lake water should have opportunity to vote on the question of issuing bonds to pay the cost of constructing the system.

In recommending that the construction of the Clear Lake water-supply system be undertaken by the joint efforts of the state and the municipalities affected, it is suggested that the state for its institutions and the cities and towns work out independently the problems of finance relating to the taking over, extending and improving of existing distributing systems within their respective corporate limits or of constructing new distributing systems, including distributing reservoirs, and maintaining them.

Regarding probable revenues from the proposed Clear Lake water-supply system, there is no reason why the revenues from water consumers based on liberal rates, could not easily pay the interest on bonds, and sinking fund requirements for ultimately retiring bonds, together with the annual expense of maintenance and operation of both main-supply pipe line and distributing systems, besides leaving a surplus for extensions and improvements to distributing systems.

Under the plan of operation of the Metropolitan Water and Sewerage Board in Massachusetts, the annual bond interest, sinking fund and maintenance requirements are assessed upon the several municipalities, one-third in proportion to the several assessed valuations and two-thirds in proportion to the quantity of water used in each municipality during the preceding year. This feature might be adopted in the plan of organization and operation of a similar board here.

Utilization of Water Power

Comparison of elevations of some of the important points mentioned in this report demonstrates the feasibility of delivering Clear Lake water by gravity under suitable pressure (87 pounds) to the Willamette Valley cities and towns proposed to be supplied with this water.

These elevation are as follows:

	Feet.
Clear Lake (approximately	3,100
Blue River (approximately)	1,100
Eugene	426
Salem	163

The difference in elevation between Clear Lake and Blue River is 2,000 feet. All of this distance will be covered, it is assumed, by the pipe lines of the proposed hydro-electric power developments. From Blue River, the proposed point of diversion for the community water supply (at the tail-race of the lower power plant) to the City of Eugene, there is ample head to enable the delivery of water at Eugene at a pressure of 87 pounds. It is feasible to deliver the water to the principal municipalities named in this report at a similar desired pressure which is ample and about the same pressure as normally obtains in the City of Portland.

Place of Proposed Diversion

The fact that the McKenzie Valley Irrigation & Power Company contemplates bringing the water of Clear Lake and the upper McKenzie River in pipes (the flow

to be undiminished in quantity and undeteriorated in quality) from the lake outlet to Blue River, a distance of 30 miles, for power purposes, requires that it be proposed to divert such portion of the river's flow as may be required for the community water-supply at a point just below the tail-race of the lowest of the four power plants.

Classes of Construction Considered

From this diversion point it is proposed that the water will be conveyed down as far as Salem thru a continuous wooden-stave pipe similar to that used in the Seattle and Denver water-works systems, or a steel pipe line similar to that constructed from Bull Run River for the City of Portland. As an alternative, a reinforced concrete conduit could be constructed at the upper end of the line where the head is not excessive for that class of construction.

The total length of main-supply pipe line from the diversion point to Salem would be approximately 116 miles.

The main-supply pipe line would vary from 44 inches to 36 inches, internal diameter.

Quantity of Water Deliverable

Under the state condition of size of pipe and head (differences in elevations) the tentative plan recommended is for the construction of a pipe line having a capacity of 46 second-feet, which will deliver 30,000,000 gallons daily to the Willamette Valley communities.

Based on a consumption of 150 gallons daily per capita, which is a liberal allowance, this would be ample supply for 200,000 persons.

Assuming the estimate of 200,000 population to be served in 1940, about 25 years hence, might be less than the total population then, the amount of water delivered (30,000,000 gallons) would still be ample for all purposes if the cities installed meters in the distributing systems. Serving water thru meters effectively conserves water supply and prevents waste, particularly in summer when consumption is greatest.

CLEAR LAKE, *Looking Southeast.*

IDEAL PLAYGROUNDS

By Dr. A. W. Dunning, St. Paul, Minn.

THE ideal playground is essentially a piece of ground sufficient in size to accommodate all of the children of a neighborhood within a radius determined by reasonable accessibilit. This is pretty accurately indicated by the boundaries of the school district. This ground is to be adequately enclosed to facilitate control by the play leader, and to afford protection against depredations from without. The enclosure is enhanced by at least a five-foot border of planting, which lends a touch of nature to the setting. Add to this a minimum of apparatus, sand piles and wading pools for the little tots with ample shade and numerous swings. For older children add a few simple pieces of apparatus, bats and balls, footballs, quoits, tennis racquets and balls and other outfits for the organized games, and you have the setting for a playground of the first or simplest class. But the most essential factor is still lacking, i. e., the play leader. I say the most essential factor advisedly; for without a proper play leader all this does not constitute a playground, any more than a fine house without furnishings and a home-keeper constitutes a home. A playground without proper supervision and leadership is sure sooner or later to foster vice among its patrons, and it becomes a menace to the community rather than a benefit. But install in that ground a woman or a man, or both if possible, who have in full measure the love for children and for child life in their hearts, and added to that a training in the varied arts pertaining thereto, and you have established an institution whose influence for good in the community is second to none.

Elaborating upon the plan sketched above we formulate a playground of the second class, made possible only where a space of some ten acres is available. The chief difference lies simply in the addition of the larger field games, basket ball, football, baseball, tennis, croquet and many others which, together with more elaborate outdoor gymnasium apparatus, make it suitable for boys and girls thruout the grades.

For the playground of the third class, or the athletic field, a space of twenty or more acres is desirable and this should be treated so as to afford every facility for the organized sports of the boys and girls of high school age, and for these numerous organizations for field games among the working men and boys thruout the city. Each of these grounds of the second and third class should, of course, be under the control and leadership of a man whose personality and training fit him to guide his followers in clean sport, manly bearing and the practice of the square deal at all times.

The ideal provision for playgrounds in a city would place at least one in each grade school district, preferably adjoining the school yard. This would mean some sixty playgrounds of this class in St. Paul. Then there should be one of

A New York City Playground; one of the first class

the second class so located as to accommodate each group of, say four to six schools, and lastly one of the third class in each of the principal divisions of the city and its suburbs. In St. Paul this would mean at least three of the latter class.

Thus far I have said nothing about parks; for the central idea of my discourse has been the individual small citizen, and the influence upon him of his environment. However, I would treat every playground as a park so far as possible, i. e., by the planting of trees and shrubs, flowers and grass in every available space that could be spared from its utilitarian purposes. I would make each playground as beautiful and attractive as possible, both to the children and to the older people of the district. Then too, every city park should be a playground in the broadest sense. The first function of a park should be to provide real recreation for young and old alike while at the same time presenting such beauty of landscape, tree, flower and shrub as to furnish a powerful uplift to the better side of man's nature.

The tendency in modern city building is more toward utilizing the parks for the comfort of the people, and less toward making them mere beauty spots with warning to "keep off the grass" on every hand. The plan of developing a system of parks and playgrounds combined, is perfectly practicable, and this is done very satisfactorily in some cities. Much has been said and done, of late, relative to school gardens for children. Here again is a splendid institution for development of the better side of child life, a love for growing things, while at the same time fostering habits of industry and the ability to produce something directly from the soil. The value of this experience in the lives of the children and youths of a city community is undoubted and its measure is beyond computation. The enterprise was started by another group of earnest people who have the zeal and ability to demonstrate its value. As the plan develops it should become a recognized factor in our municipality, and so correlated as to take its proper place under the department of child development. Thus will be furnished

TAMALPAIS *Recreation Center, Kentfield, Cal.*

WADING BASIN, *McKinley Place Playground, Cincinnati, O.*

another means for work to alternate with play in a most desirable form.

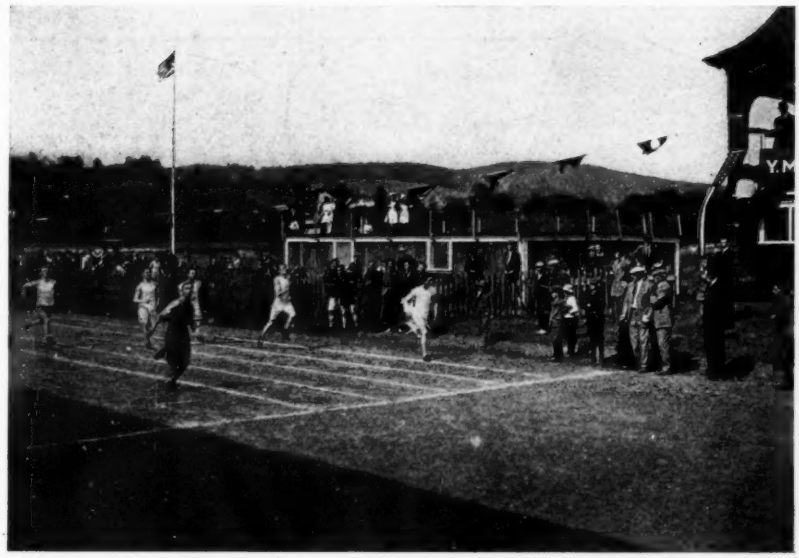
One of the most difficult problems to solve in connection with the public playground is its proper relation to the school, and the best plan for its supervision. Leading educators everywhere are heartily in favor of the playgrounds, and urge that they be made a part of the school system, financed by the boards of education, and that the play leaders be furnished from among the teachers.

This would seem the most natural and economical plan, but when one considers the already overworked teachers and the proverbial difficulty which school boards everywhere encounter in getting funds to carry on purely educational work, one finds that it does not work out well in practice, as is evident in several large cities where this plan has been tried.

Many close observers agree, therefore, that for the present, at least, it is best that they should be financed and supervised by a separate body, such as the park board or an independent recreation commission, but working in close co-operation with the teachers so as to supplement their work in the highest degree possible.

The problem of financing is always a difficult one. The protest is going up all over the country that the bonded indebtedness of cities everywhere, is becoming too great. This protest comes, not alone from the grudging taxpayer, but from careful students of civic welfare and from serious minded business men. Very naturally, under these conditions, a proposal such as I have made above; to establish a complete system of playgrounds, entailing the purchase of land, costly apparatus and adequate buildings, as well as the employment of a large number of high grade people upon salary, and thereby establishing a heavy fixed charge for all time; brings forth a vigorous protest from the men who control public affairs in our city, and we are called visionary, and exceedingly impracticable. But look at this matter from another angle for a moment and tell me who is the most practical man. My thesis, which is supported by sociologists, educators and close observers everywhere, is this: The playground for children is a most powerful factor in the upbuilding of the health, character and spirituality of the coming generation. In doing this it tends to lessen the needs for hospitals and all institutions for defectives, to lessen intemperance and poverty, thereby saving untold cost of almshouse, jail and court. Thus it requires no visionary temperament to conclude that my proposition would prove an excellent investment in money alone. It seems to me that he who proposes to apply the effective measure of prevention, in early child life, is like the man who carries the bucket of water to extinguish the incipient blaze and thereby prevents the conflagration; while

THE GAME *that makes for the square deal; part of a playground of the second class.*



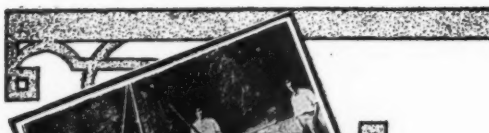
FINISH *of a close dash; a glimpse of an athletic field of the third class.*

he who would pour in large sums of money to provide institutions for the care of the disabled and delinquent classes after gross neglect in child life, is like the man who spends his energies in pouring buckets of water on the fully developed conflagration. Which is the more practical man?

This question of finance is a vital one and must be decided by the people. It is like all other questions of great public interest; when once the people realize the actual value to the race of the institution of the public park and playground, the means will surely be forthcoming.

The boys and girls of today are the men and women of tomorrow, and the public playground, properly equipped and directed, is one of the very strongest agencies in building citizens of character, health and independence.

PARK PLAYGROUND *in Troy, New York.*



EDITORIAL

ROAD SURFACES, FOUNDATIONS AND THE TRAFFIC CENSUS

Thus far in our road experiences we have been groping, trying to find out what was the reason for each failure in road construction which has developed, and then improving the road to meet our idea as to the cause of the difficulty. We have now gathered a considerable amount of data and are adding to the collection daily.

Some of the information is as old as the Romans and still we have not learned to apply it rationally because the data necessary to fill the gaps in the course of reasoning are only now collecting.

The old Roman roads had heavy foundations. The French roads have heavy foundations. Both are noted for their durability, the French roads requiring only the constant patrol system to keep their surfaces in good condition until the modern traffic has changed the conditions on the main roads. English roads have less strength in their foundations, the lower layers being of broken stone rather than of heavy blocks, except where Telford's system has been followed. American roads have foundations still less stable than English roads, when considered as a class, and many roads built under the county system have little or no foundation.

The consequence is that the cost of maintenance of American roads is out of all proportion to the amount of traffic over them, and we are only just learning the lesson which was set for us centuries ago. The tendency toward better drained and heavier foundations for all roads is becoming stronger every year. As the foundations improve the cost of maintaining the surfaces of the less traveled roads diminishes, and we will, one of these days, be able to select the most economical foundation for the traffic to which the road is to be subjected.

Main roads have an additional reason for rapid wear in the modern traffic, to say nothing of the increase in traffic. The difference in effect of the local traffic and the main road traffic is demonstrated on the French roads. The local roads are generally in good condition, tho having lighter foundations and less constant attention, but the main roads, tho costing four or five times as much per mile for maintenance, are rapidly approaching the time for reconstruction.

This modern traffic developed first in the fast moving automobile. But this is followed by the automobile trucks and the conditions are again changed. A treatment of the surface which would prevent raveling under the automobile was first considered sufficient, but the heavier traffic now demonstrates again the necessity of heavier foundations and the tendency now is toward them, even to the extent of making them of concrete on the most heavily traveled roads. The next step, to more permanent surfaces, is then easy to take and in the vicinity of large cities we have the concrete foundations and brick or cement concrete or bituminous concrete wearing surfaces.

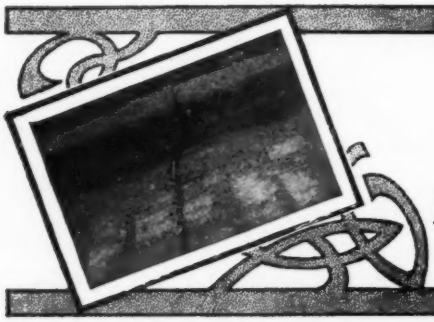
The modern tendencies are therefore toward better foundations for all roads subject to traffic of any weight beyond pleasure vehicles, and heavy foundations for the heavily traveled roads. As regards wearing surfaces there is a tendency toward the old macadam or gravel top layers on the better foundations for all the lighter traffic roads; dust layers for those traveled largely by pleasure vehicles, and permanent surfaces for the heavily traveled roads. Roads under intermediate conditions are built by using the various methods of applying bituminous binders.

There are many mistakes made daily in selecting the proper materials and methods of construction for new roads, because of lack of definite knowledge of the actual conditions of traffic and of poor judgment as to the effect of the improvement of the road in attracting more and heavier traffic. The only way to lessen the number of these mistakes is to gather the necessary information. One of the most important methods of collecting data is the traffic census, which should include not only the number of vehicles, but their kind, weight, speed, kind of tires, method of propulsion. This material should be supplemented by a study of the effect of a similar improvement upon another road in similar location, with a careful comparison of the respective chances for new traffic from various sources, so that there may be a reasonable chance for accuracy in predicting the kind and amount of traffic to which the road will be subjected.

New road commissions are likely to follow the demands of their constituents in their early work and thus throw discredit on the good roads cause by building roads which will be barely, if indeed they are quite, sufficient for the conditions of the past, only to see them go to pieces promptly under the new traffic to which they are bound to be subjected. The older commissions have gone thru that stage and their troubles should teach the newer commissions their lessons. Will they learn them easily or only by passing thru the whole of the experimental stage?

HIGHWAY LEGISLATION

Many legislatures are closing their sessions as this number of MUNICIPAL ENGINEERING goes to press or will shortly do so. Most of them have done or promise to do well by their country roads. The Indiana legislature completed its work early in March and with great difficulty succeeded in passing a law making it possible to establish in each county the patrol system on county roads under the supervision of a single county road superintendent who can be as competent as the county commissioners desire within the limits of the compensation of $4 or $5 a day. Another law providing for the payment of township road taxes above $20 in amount in cash will help to eliminate from future legislative sessions the lobby against all road legislation which might interfere with the small group of men who made much money in farming out the road taxes of railroads and other corporations and may make it easier to pass progressive road laws at future sessions. The same law provides for the appointment by township trustees, instead of the election, of township road supervisors, making them responsible to the township trustee and thus giving him an opportunity to improve the road situation in his township if he desires. No state highway law could get thru, not even one providing a commission to report to the next session. One of the best bills on that subject which has been presented to any legislature was up for consideration, but could not be passed because the county members could not understand it and feared that it would interfere with their local control of roads, altho no provision in it could be so construed, except so far as the few miles of road to be constructed with state aid were concerned.



MEN PROMINENT IN MUNICIPAL AFFAIRS

Photo by Moffett, Chicago.

PAUL E. GREEN, *Consulting Engineer.*

Paul Evans Green

Consulting Engineer, Chicago, Illinois

Paul E. Green, Consulting, Civil and Sanitary Engineer, member of firm, Aetna Engineering Bureau, Chicago, Illinois. Graduate of the University of West Virginia 1899; 1899 to 1905, engaged on railroad bridge and valuation work; in 1905, engaged on design of hydraulic work by the state of New York in connection with the construction of barge canal between Lake Erie and the Hudson river.

In 1906, Mr. Green entered the employ of the city of Chicago, as Division Engineer in charge of the construction of

street pavements in the north district, embracing all territory north and east of the Chicago river to Devon avenue, with a population of approximately 400,000 people.

This work included the supervision of all streets paved by special assessment and private contract; preparation of preliminary reports on proposed improvements, preliminary estimates and separate plans and specifications for each street and alley to be paved; entailing an expenditure of some $1,000,000 annually.

In 1910, he resigned his position with the city of Chicago and entered upon his present duties. Since becoming a member of the firm with which he is now connected, Mr. Green has had charge of many engineering projects thruout the country, the more important of which are: Investigation and report as to the improvement of Sheridan road from Chicago to Lake Forest, Illinois, involving an ultimate expenditure of several millions of dollars; special expert work for Chicago in connection with pavements damaged by street car traffic; Elyria, Ohio, examination and report on revision of water works plant and installation of high pressure system; Longview, Texas, design and construction of street pavements, storm water sewer system, electric light system and concrete bridges.

He is a member of American Society of Civil Engineers, Western Society of Engineers and Illinois Water Supply Association.

J. T. Miskeal, Purchasing Agent for Memphis

The great loss due to the buying of supplies for a city by separate departments without the co-operation of other departments has been very successfully overcome by the city of Memphis, Tenn. As a result of the co-ordination of all purchases through one purchasing department the city has saved many thousands over the old prices and, just as important, has been the keeping of departments properly supplied at all time, thus eliminating a large waste in the time of men due to unnecessary waiting for stock.

When the commission government was inaugurated, a purchasing agent was appointed who had spent many years in the employ of one of Memphis's largest wholesale houses as a buyer. This experience equipped him with a keenness and ability which few cities have the good fortune to command for their own benefit. The many efficiency methods established by Mr. Miskeal have placed the purchasing department of Memphis on a par with the methods used and results attained by some of the largest business corporations in the country. The buying of supplies

J. T. MISKEAL, *Memphis, Tennessee.*

to keep 133,000 people protected in health, physical safety and mental well being—purchases for police, fire and engineering departments, purchases necessary to keep streets clean, properly dispose of garbage, to operate the city buildings, to keep parks in such condition that they may be a joy to the people, all entail an amount of detail that only a man of ability and executive capacity can effectively handle. That Mr. Miskeal has such qualifications is exemplified in his compact and efficient organization, which, with the exception of a number of clerks, is handled by himself and his assistant, Mr. Dave Wells.

Under the plan now in force every purchase made for the city must be covered by a requisition approved by the head of the department ordering it. These requisitions are carefully examined and the need investigated by the City Commissioners before official approval is given. The properly authorized requisition is then passed on to the city purchasing agent. This, very briefly, illustrates the fundamentals of operation. However, there are in force in the purchasing agent's office many efficient and unique methods of cataloguing prices for immediate reference, systems whereby deliveries are checked and orders followed up for prompt delivery.

The purchasing department receives bids on all supplies, materials and so forth and the order is given to the firm quoting the lowest price, quality considered. As a result of this method business houses have learned to quote the city the same low prices that they would

any other class of trade in which competition is keen.

The department has paid for itself many times over. Not only has it brought about a great saving in the cost of supplies, but the system has also effected a great economy in the operation of all departments of city government. This is largely due to the fact that city employes are no longer permitted to pick up the telephone and order supplies indiscriminately from any one they choose and at any price that may be quoted at the time.

William D. Barber

Assistant Engineer, Department Public Works, Chicago, Illinois

William D. Barber, member American Society of Civil Engineers, Assistant Engineer, Department Public Works, Chicago, Illinois, was graduated from the University of Illinois in 1892, with the degree of Civil Engineer. After four years' experience as Construction Engineer with

WILLIAM D. BARBER, *Chicago.*

the George A. Fuller Company, high building contractors, Mr. Barber entered the services of the city of Chicago as Engineer of Construction.

He was placed in charge of Section 3 of the Northwest Land Tunnel, consisting of 4½ miles of brick tunnel, 8 feet in diameter, constructed thru rock.

In 1899, Mr. Barber was placed in charge of the Construction and Repair Division of the Department of Public Works. Here he had charge of carrying on such repair and construction work as was done by the city. The plant then consisted of a brass foundry, an assembling room, a machine shop, a pattern shop, a carpenter shop and a cabinet-making room, which was sadly in need of an expert on organization and efficiency.

Recognizing the importance and future possibilities of such a plant, Mr. Barber made a thoro study of the organization, equipment and exist ng conditions, and proceeded to remedy, so far as was in his power, the more glaring defects, the result being that, today, the plant will compare favorably with any of its kind in the country.

In 1908, he was placed in charge of the construction of the Blue Island Avenue Land Tunnel, constructed thru rock and earth for the purpose of supplying the southwest portion of the city with necessary water facilities. This tunnel consists of 29,569 lineal feet concrete-lined tunnel, varying in diameter from 6 feet to 8 feet.

Since 1910, Mr. Barber has been in local charge of pumping station improvements and betterments, special work on intercepting sewers and the organization and direction of municipal employes engaged in construction work.

The Chattanooga Municipal Record

When the new Board of Commissioners of Chattanooga, Tenn., assumed charge of the government of the city, they established the "Municipal Record," now in its second volume, under the provisions of the act creating the commission. The paper is compiled and issued by the Department of Public Affairs and Finance, Hal F. Wiltse, the secretary to Mayor J. C. Thompson, who is the head of the department, doing the editorial work. The publication is of much value to taxpayers and voters.

Cement Trade With Foreign Countries

Cement imports during 1912 were less than half what they were in 1911. They have fallen to about 68,000 barrels a year, as compared with a maximum of about 3,000,000 barrels a few years ago.

Exports of American cement increased 25 per cent and were 4,215,532 barrels in 1912, as compared with a few thousand a few years ago.

In fifteen years this reversal of trade has taken place, due to the development of cement manufacture in this country.

QUESTION DEPARTMENT

Form of Charter for Small City

We have under consideration a city charter, which will include three villages with an estimated population of 10,000. Any information that you have in this matter will be greatly appreciated by us.

F., Village Clerk, ———, N. Y.

The National Short Ballot Organization, New York City, and the National Municipal League, North American building, Philadelphia, Pa., have paid considerable attention to the subject of city charters and will doubtless give all the information they can on request.

MUNICIPAL ENGINEERING has had a good many articles in the past on this subject, and particularly the articles in vol. xliii, p. 105; vol. xli, p. 257, and vol. xl, pp. 30, 45, 124, 126 and 127. These may not give exactly what is wanted, but they discuss various phases of the subject, which would probably be of value in working ou the principle on which a new charter should be based.

Properties of Slag Concrete

Will you kindly give us information regarding the use of open hearth slag, ground up or pulverized and mixed with good portland cement, its heat conductivity and what its tenacity and strength is?

J. B., Cincinnati, O.

In vol. xlii of MUNICIPAL ENGINEERING, p. 119, is a brief article on the subject, which indicates that slag is approximately as good for concrete as limestone. One man who has made many experiments on slag sand declares that mortar made with it. has from 10 to 36 per cent greater tensile strength than mortar of same proportions using river sand. In his experiments he shows that slag concrete compares favorably with concrete of other standard materials in compressive strength. Slag and cinder are fire-resistive materials and their heat conductivity is low on account of the voids in those materials, but when they are mixed with Portland cement, these voids are more or less filled by the cement and so the heat conductivity is increased. This is indicated by the greater percentage of increase of weight of cinder concrete over the cinder itself than of limestone concrete over the limestone itself. Cinder and limestone when compared show that the weight and the compressive strength of the cinder concrete are from 60 to 65 per cent of that of the limestone concrete. Slag concrete would probably have both weight and strength more than cinder concrete, but no one has as yet taken enough interest in the subject to make any long series of experiments. Slag is used in the concrete for the foundation of pavements in a number of places where it is available, and is used very successfully, but its use is restricted necessarily to the vicinity of the mills of which it is the product.

Can our readers supply any additional information of value?

History of Brick Paving and Fillers

Will you kindly state where and when vitrified brick paving is first known, in this country at least, with a brief resume of the course of development of fillers for the brick to the present, and with more particular reference to expansion provisions in filling with cement?

Are there anywhere reports of experiments or experience with placing the brick diagonal rather than right-angled to the line of street?

V., City Engineer, ———, O.

The credit for the first use of brick as paving material in this country is claimed by Charleston, W. Va., with a sample in 1870, and a block in 1873 and by Bloomington, Ill., with considerable area laid in 1875. These pavements used sand for filler. By 1895, when Wheeler's little book on "Vitrified Paving Brick," appeared, tar or pitch and cement had been added to the list of fillers, Wheeler expressing his preference for cement as building the pavement into a monolith and not being affected by hot weather.

When the first edition of Baker's

"Roads and Pavements" appeared in 1903, sand was still the most common filler and cement was next. He describes in detail the difficulties from expansion, but it is evident that the use of expansion joints along the curb is not common, for he suggests that the rumbling of the pavement can be prevented by such joints filled with tar. He also suggests transverse joints filled with tar at intervals and gives instances of the amount of material used.

One of the pavements, South Sixth street in Terre Haute, laid some twenty years ago, which still has a perfect surface, cement filler, had no expansion joints and would undoubtedly have failed from expansion if the soil had not been light enough, so that the curbs were pushed back the necessary amount. Since that date, but more particularly in the last ten years, the stress laid on proper workmanship has gradually brought the quality of brick pavements with cement filler up, and the curb and other construction has also improved, so that the necessity for expansion joints along the curb has become more apparent and they are now carefully specified. Some engineers have made careful specifications for them almost from the beginning, but they are now important parts of the generally adopted standards.

The subject of transverse expansion joints is fully discussed in recent numbers of MUNICIPAL ENGINEERING, vol. xliv, p. 96 on "Prevention of Defects in Brick Pavements," p. 106 on "Brick for Country Roads," p. 114, "Good Brick Pavements."

Mr. Baker reports, in the book referred to, that a few cities lay bricks at 45 degree angle, but considers that there is no advantage in this and some disadvantage in laying. Observation of intersections, which are laid diagonally, partly to prevent driving lengthwise of the bricks and partly because vehicles turning the corners follow approximately the perpendiculars to the courses, indicate that the wear is more rapid and less uniform over such diagonal courses.

Bituminous fillers have also improved and some engineers prefer them to any other.

How to Keep the Accounts of a Municipality

I would like very much to get information concerning the best methods of keeping the accounts of a municipality. Is there any regular system in general use, and is there any that would be simple and yet complete that you could recommend? I am both city clerk and tax collector, and have more than I can attend to under the present system.

G., ———, Tex.

The state of Massachusetts has done much in standardizing methods of keeping municipal accounts. Information can probably be obtained from the State Bureau of Statistics, at the State House, Boston, Mass.

Ohio has established a State Bureau of Accounts, which has supervision over the forms of accounts and reports of all the municipal organizations in the state, city, village, county, township, etc., and the chief of this bureau at Columbus, O., can supply much information in his annual reports and otherwise. Blanks and books for the accounts and reports are made by publishers and sold to the municipalities, which conform with the requirements of the bureau, and names of such publishers can be given by the chief of the bureau.

The State Bureau of Accounts of Indiana has also done something in this line, although most of this work has been with township and county officers.

Books on the subject are "Municipal Accounting," by F. H. Macpherson, which gives forms for books of all sorts, published by the Bookkeeper Publishing Co., Detroit, Mich., in 1901; "Quasi-Public Corporation Accounting and Management," by John F. J. Mulhall, treating mainly of water works bookkeeping and accounting, but covering other public service utilities.

Articles on Use of Cement Concrete for Street Paving

I desire to secure a list by title and subhead of any articles which have appeared in MUNICIPAL ENGINEERING since about 1897 relating specifically to straight concrete (base and topping) for paving. SUBSCRIBER.

Following is a list of such articles:

In vol. xliv: "The Thomas System of Reinforced Concrete Roads and Pavements," p. 158.

In vol. xliii: "Concrete Roads, What They Cost," p. 44; "Thomas Steel Reinforcing for Pavements," p. 342; "Patents on Road Construction and Repair," pp. 102, 127; "Qualities of Concrete Pavement," p. 255, giving references to earlier articles; "Specifications for Concrete Street Pavement, p. 253.

In vol. xlii: "The Blome Concrete Pavements," p. 340; "Comparison of Cincinnati Pavements," p. 458; "Patents on Road Construction and Repair," p. 68.

In vol. xli: "Mixing Concrete for Street Paving," p. 50; "Patents on Road and Pavement Construction and Repair," p. 410; "Paving in Mason City, Iowa," p. 461.

In vol. xl: "Reinforcement for Concrete Pavements or Floors," p. 223; "Cement Concrete Paving in Mason City, Iowa," p. 174.

In vol. xxxix: "Fond du Lac's Cement Streets," pp. 136, 284; "Street Paving in New Orleans," p. 260; "Concrete Pavement in Delphi, Ind.," p. 294; "Concrete

and Macadam Streets of Richmond, Ind.," p. 281; "Expansion Joints in Concrete Pavement," p. 213.

In vol. xxxviii: "Specifications for Concrete Sidewalks, Curbs and Gutters and Pavements," p. 244; "Articles on Concrete Paving," p. 419.

In vol. xxxvii: "German Artificial Stone Paving," p. 121; "Patents Concerning Street and Road Construction and Repair," p. 277; "Will a Concrete Street Crack," p. 35; "Cost of Street Paving," p. 177.

In vol. xxxvi: "Efficiency of Concrete Pavements," p. 32.

In vol. xxxv: "Cement Macadam Streets in Germany," p. 36; "A Concrete Pavement in Bozeman, Mont.," p. 389; "The Blome Concrete Pavement," p. 369; "Experience with Concrete Pavements," p. 180; "Concrete Street Paving in Allentown, Pa.," p. 254.

In vol. xxxiv: "Information About Concrete Pavements," pp. 168, 237; "Concrete Street Pavements," p. 357; "The Evolution of Pavements," p. 336; "Municipal Engineering at Gary, Ind.," p. 329.

In vol. xxxiii: "Concrete Pavement in LeMars, Iowa," p. 412; "Patents Concerning Roads and Pavements," pp. 134, 284.

In vol. xxxii: "Concrete Pavements," p. 89; "The Hassam Pavement," p. 252; "Concrete Brick for Street Paving," p. 317.

In vol. xxxi: "Specifications for Cement Street Pavements," p. 102.

In vol. xxx: "Specifications for Brick and Concrete Alley Pavements," p. 430; "Concrete for Steep Streets," p. 202.

In vol. xxviii: "Concrete Paving and Paving Materials," p. 386.

In vol. xxvii: "Concrete Pavements in Toronto, Can." p. 350.

In vol. xxiii: "Some Concrete Constructions in Grand Rapids, Mich," pp. 400, 436.

In vol. xix: "Cement Streets in Bellefontaine," p. 427, also in vol. xvii, pp. 383, 384, and vol. iv, p. 229.

Responsibility for Errors of Engineer

Our water supply was inadequate. An engineer came here and made a preliminary survey. Then he came back after the city council had told him what system they wanted to work under. By contract the engineer agreed to "lay out the work for the successful bidder, and, when work has been installed by said bidder, inspect the same, and if it is found in accordance with the plans and specifications, the work to be thoroughly tested and approved and turned over to parties of the first part."

He came here, but did not lay out anything except on blueprints, and commenced to O. K. every estimate sent in by the contractor. A lot of defective pipes were sent out, marked "personal inspection," which were weighed and found far below what the plans called for. Personally he came out here and approved some cement beams, and when the forms were taken off they fell of their own weight. The cement beams were worthless. By this time the engineer had been paid about $500. The council then discharged him. Another engineer took charge. He found plans very deficient, and when he investigated he learned that two of the Cook points had been stuck in blue shale or mud and were a loss to the city of about $500. Hardly a year had passed until the city faced another water famine. A big well had to be dug at a cost of $4,500. The engineer who drew the plans never made any test holes where the Cook points should be placed. Our district court held that he was not obliged to make any test holes; was not required to make any estimates, and if he was careless or negligent in this respect the city could not hold him, for this part was only voluntary and was beyond his contract. And that if he furnished plans, on blueprint, and made final inspection and the city accepted, engineer was entitled to balance due, $365. They accepted the work and that settled it.

H., City Attorney.

The engineer under city employment is apparently on the same basis as a city official, especially after his work has been accepted by the city officials, and consequently he is not held for errors of judgment any more than city officials are.

There might be conditions demonstrating fraud which would modify this general condition, but they must, of course, be brought out on the trial. There seems to have been no decision to any other effect. Have our readers any knowledge of court decisions on this question?

Durability of Concrete Pavement With Asphaltic Concrete Wearing Surface

Can you furnish usable data as to cost and durability of pavement of 4 or 5-inch good cement concrete base, with 2-inch asphalt concrete wearing surface, both base and top to be made with good hard washed gravel, two to three parts good sharp sand to five of gravel? Some parties desire such pavement on a certain street instead of brick, but such pavement is, so far as my acquaintance goes, experimental, with no doubt its own peculiar problems to be solved. If you can furnish data or refer me to some one who has used such or similar pavement long enough to give it a fair trial, I shall thank you.

N., ———, Ill.

The writer has not had personal experience with exactly the kind of pavement described and does not know where it has been used, altho pavements of about the same description using broken stone in the asphaltic concrete, have been used with reasonable success. Contract has just been let on elaborate specifications for this sort of pavement in Schenectady, N. Y., which were in use in Milwaukee for two years previously.

Will our readers give any information which will help our correspondent and others?

How to Make a Municipal Budget

I am particularly anxious at this time to secure information relative to budget-making for this municipality, and if you have

any information along this line, or can give me any information relative to the drafting of a budget, I shall very much appreciate your kindness.

S., Mayor, ———, Md.

Much of value on this subject can be obtained from the Bureau of Municipal Research, New York City, and the National Municipal League, North American building, Philadelphia, Pa. Both of these organizations have paid considerable attention to budget making and can give much assistance on the problem. The Bureau of Municipal Research has brought about a great reform in the matter of preparation of the budget for New York City, which is much larger than this city, but it has extended its energies into other smaller cities, so they will be able to give what is wanted. The National Municipal League has discussed the subject in its annual conventions and the secretary can at least supply the annual volumes of proceedings containing material of interest in this connection.

MUNICIPAL ENGINEERING would like to publish the results of such efforts as this. Not many cities pay any attention whatever to their budgets. Some of them really apply the proper principles, but in such a loose way that no one can ascertain just what the basis of their work is. Others simply live from hand to mouth. The experience of any city will be of interest to our readers and will be published if sent for that purpose.

Expert Wanted to Test Electric Light System

This city desires to employ one or two good men to test the candle power of the street arc lamps and to determine the cost to maintain and operate same.

G., City Attorney, ———, Ky.

This request is referred to our readers.

Makers of Garbage and Refuse Destructors.

Kindly inform me as to names of manufacturers of crematories and incinerators, etc., for disposing of garbage, street cleanings, dead animals, etc., such as will accumulate about a city.

Our city will have to make arrangements for a new plant at an early date, and I have been asked to secure information.

W., ———, N. C.

Reference may be made for the names of such manufacturers to the Business Directory published in each number of MUNICIPAL ENGINEERING under the heading, "Garbage Disposal Plants." The magazine has much on this subject, the current volume containing, "Garbage Disposal in Canton, O.," p. 141; "Garbage Reduction in Chicago," p. 137. Other plants are described in previous volumes.

Repaving Asphalt Street With Brick

Will you kindly inform me if you have any records of or references to the use of vitrified brick for repaving asphalt streets and the methods for laying same. Also, what depth of brick has been used? If possible, will you also give me the names of any cities where such construction has been used?

S., City Engineer, ——, N. Y.

Can our readers refer our correspondent to cities doing what he proposes?

The brick is thicker than the asphalt wearing surface, especially when a sand cushion is used. If it is possible to reduce this sand cushion to a minimum, it might be possible to relay the brick pavement parallel to the concrete foundation with the exception of the gutters. These might be laid at or near the present elevation so as to interfere as little as possible with the drainage of the street, and a row of beveled brick might be used to make the connections between the pavement proper and the gutter. Perhaps it would be well to construct the gutter and this beveled section of cement, so that it would make a straight line between the cement gutter and the brick pavement. Otherwise it probably would be necessary to produce the beveled surface on some of the brick used in breaking joints by chipping brick, which would not be a very satisfactory operation.

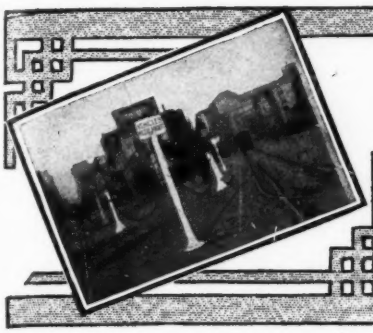
Mileage of Asphalt Pavements

If you have any data relative to the total mileage of standard asphalt pavements laid in the principal cities of this country, I would greatly appreciate if you would supply me with this information.

H., Inspector of Asphalts and Cements.

The best place to get information on this question is in the special reports of the United States Census Bureau. This bureau publishes occasional volumes of statistics of cities. The financial statistics are collected annually, but the last volume of other statistics is that for 1907 for cities of over 30,000 population.

According to that publication there are in cities of over 30,000, 75,437,652 square yards of asphalt pavements. If we assume the average width of street to be 30 feet, this would make the mileage 4,286. Of this amount 47,000,410 square yards are in cities of over 300,000, 15,295,187 in cities between 100,000 and 300,000, 8,478,411 in cities of 50,000 to 100,000, 4,663,644 in cities of 30,000 to 50,000. These figures include asphalt blocks, but as the proportion of the blocks is small, it makes but little difference in the total.



WORKERS IN THE FIELD

Cause of Flooding of Batavia Sewage Pumping Plant

The Editor of MUNICIPAL ENGINEERING:

Sir—The recent trouble at the Batavia sewage pumping station has, for a reason apparent only to a few, called forth undue criticism in recent periodicals. It is due to the engineering profession at large that a true statement of the cause should be placed before them.

The system here comprises 32 miles of separate sewers draining to a central pumping station. These sewers range from 8 inches to 27 inches in diameter and to a maximum depth beneath the surface of 23 feet. The geological formation in the village is glacial, with its topography nearly level. The glacial drift has been deposited in a very irregular and uncertain manner. The valley ways were originally swampy. The Tonawanda creek flows thru the village and, in times of spring freshets, overflows its banks. The ground water level averaged 5 feet beneath the surface at time of construction, resulting in shallow, yet wet, cellars. The result of the above conditions was that four-fifths of the sewers were constructed in water-bearing material, with a possible large infiltration thru the joints of the sewers.

Infiltration of Ground Water

Yet under the above conditions the highest rate of combined sewage and ground water flow reaching the disposal plant and measured over thin-edge weirs and for periods of eight hours was at a rate of 3,000,000 gallons in 24 hours. This rate for the maximum period of flow, according to excellent authorities, makes the approximate average flow in 24 hours at about 2,000,000 gallons, including sewage from 2,500 house connections, factories and infiltration from 32 miles of sanitary sewers. If we neglect the house connections, and assume the average house contains 4½ persons, using a per capita amount of 83 gallons per day, which is probably low, we arrive at the conclusion that the maximum infiltration is at most 1,066,250 gallons per day, or at a rate of 33,333 gallons per mile per day. The capacity of the sewers and of the pumps had been figured to receive 50,000 gallons per mile per day. When it is considered that in above estimate we neglect approximately 15 miles of house connections and that the sewers thruout were built in water-bearing material under present heads of 0 to 10 feet, excellent results from the construction are indicated. It may be of interest that the building of the sewers has resulted in drying up wells to a depth of 16 feet thruout the village, showing that the original intention of lowering the ground water table has been well accomplished. The original design of the sewers called for a future population of 25,000 using 83 gallons per capita, with ground water infiltration at the outset of 1,000,000 gallons per day. It is readily conceivable that the infiltration will decrease as time increases and the surface of the ground become more impervious. In regard to infiltration of sand, as has been questioned, we would state to date we have received no serious trouble whatsoever.

Meeting Flood Conditions

The pumping station is 32 feet in diameter and about 27 feet in depth. The bottom is divided up into six compartments. In two of these there are two 1,050-gallons-per-minute, submerged, vertical, centrifugal pumps, with a 470-gallons-per-minute similar pump in a third compartment. The shafts pass upward with the runner supported on a ball-bearing step. This step is about 12 feet above the bottom of the pumps and 2 feet above the top of inlet sewer. At the time of the trouble one of the large pumps had been taken apart for an examination. About this time a thaw, accompanied with rain, caused the Tonawanda creek to overflow its banks and to cover certain outlying and low streets. Elsewhere certain streets were covered with storm water due to the inefficiency of the old storm water system. The result was that this water naturally ran thru the perforated manhole

tops of the sewers in several places. Certain cellars of houses along the shallow creek commenced to fill with water seeping thru the walls. The occupants opened up their cellar drains and sewers. From these various causes the pump well soon received all the water that the two pumps could handle. About this time a faulty ball-bearing on the second pump broke, leaving the small one to take care of the flow. Before the ball-bearing could be repaired the plant became flooded, forcing the machinists out of the well. The sewage being, to a certain extent, gritty, very soon got into the bearing of pump No. 3 and caused the bearings to break, thus forcing a complete stoppage of pumping. Within twenty-four hours a temporary steam-driven centrifugal pump of 1,050 gallons per minute was installed at a manhole outside of the pump station and one of the regular pumps was jacked up and run on split collars fastened on the pump shaft and resting on a journal box in the basement. Within forty minutes after these two pumps commenced to run the sewage was lowered and new balls inserted in the raceways of the bearings of pump No. 3. Then pump No. 2, which had been running on split collars resting on a journal box, was repaired. Within two hours the pump station was running the same as usual, the two pumps handling the entire flow. The fact that the creek had receded only a few feet, enough to prevent surface water from entering manhole tops, is indicative that the capacity of the pumping station is ample, excepting in an extreme case of the river flooding the low streets, as above.

K. B. MATHES,
Chairman Batavia (N. Y.) Sewer Commission.

ROBERT L. FOX,
City Engineer.

Cost of Asphalt Repairs

The Editor of MUNICIPAL ENGINEERNG:

Sir—Your issue of February, page 127, contains an article on the "Inefficient Operation of Dayton's Asphalt Plant."

The facts, so far as given, may not show excellent results, but the deductions as to mismanagement seem to be equally open to criticism.

From the table, page 129, it is assumed that in the period of four years, 1908-9-10 and 11, 162,465.1 square yards of repairs were made. In 1908, there were 446,800 yards of asphalt pavement, 152,520 yards of which were under guaranty. To be liberal in estimate, it may be assumed that one-half of this pavement under guaranty came under maintenance in 1909, and all of it in 1910. Under this assumption there would have been 1,543,420 yard-years of maintenance, and, with 162,465 yards of repair, there was an average replacement or repair of 10.53 per cent per year. It is stated that in 1908 "most of the streets had been laid from twelve to fifteen years," but as over one-third the total area was then under guaranty, it may be assumed that the pavements had an average age of fifteen years during this period. This, then, would give an average annual repair rate of 10.53 per cent at 15 years' age. The rate in Buffalo, based on thirty times this experience, is an average annual replacement or repair of less than 4.5 per cent at 15 years of age, but with a cost of a little over $1.00 per yard of repairs.

The point of criticism noted is that which calls attention to the computed cost in 1910 as 49 cents per yard, while costs in 1908 were 88.3 cents and in 1911, 79 cents—"then it is evident that the plant was grossly mismanaged in 1908 and 1911."

This assumption that because repairs were made at 49 cents per yard one year, a rate of 79 cents another year represented "gross mismanagement" is, without detail of results accomplished, distinctly unwarranted. I should say in similar lack of details that any repairs made by cutting out and filling with new materials at 49 cents per yard was gross engineering malpractice. A yard of asphalt repairs is no more a definite commodity than a yard of cloth. It should be specified whether it is to be calico or velvet, and you cannot look for much wool, not to mention silk, in 49-cent asphalt repairs.

Possibly some resurfacing was done by this plant, in which case my comparison with Buffalo would not be applicable. In fact the meager data submitted are entirely insufficient to draw any conclusions or point any morals. Their publication is desirable that those interested may draw their own conclusions, but they are not sufficient tc point a moral or adorn a tale. Their attempted use can only emphasize the danger of the present tendency to apply undigested figures to "efficiency engineering" and "scientific budget making" by the expert accountant rules, considering only quantity without quality and without full engineering analysis.

GEORGE H. HORTON,
Deputy Engineer Commissioner.
Buffalo, N. Y.

Memphis Assesses Cost of Paving on Property

The city engineer of Memphis, Tenn., calls attention to the statement in the article on "Paving Conditions in Southern Cities," on p. 74 of the February number of MUUNICIPAL ENGINEERING, that

the principle of assessing the cost of street paving on the property benefitted now applies to Knoxville, Memphis and Nashville, as distinguished from the necessity of paying for all such improvements out of the general funds under former court decisions, and points out a difference in application of the principle in the cities mentioned, since Knoxville assesses but two-thirds of the cost on the property benefitted, as stated, while Memphis assesses the entire cost of the improvement upon the property benefitted.

Binder Course for Bituminous Macadam Pavements

The Editor of MUNICIPAL ENGINEERING:

Sir—The Association for Standardizing Paving Specifications, at its fourth annual convention held at Pittsburgh, Pa., February 24 to 27, 1913, after careful consideration, unanimously determined that fine bituminous mixtures, like "Topeka" specifications, should be laid on a binder course in the same way as other sheet asphalt sand mixture surfaces.

The report of the committee of the above association on bituminous concrete paving specifications, which was unanimously adopted by the association, referring to such fine mixtures under the heading, "Binder Course," contains the following: "The binder course for macadam base shall be composed of a layer of clean, coarse stone of a size that will pass a 2 or 2½-inch ring and be retained on a 1-inch ring; it shall be evenly distributed over the surface of the macadam base described above and 1½ inches, or practically one stone deep, and rolled until the stones are practically level and forced partially into the macadam base. The rolling should be comparatively light, only enough to partially imbed the stone and set them firmly in place without crushing them or forcing the fine material up from below to completely fill the voids. This rolling should be done while the macadam base is still moist and comparatively soft. The stone of the binder course may be laid on without any coating or application whatever or, second, with an application of light bitumen after laying and rolling, or, third, coated with a bituminous cement before being laid. When a concrete base is used, the binder course shall be laid as called for under the standard specifications for sheet asphalt pavements."

The above association, in standardizing and insisting on the use of a binder course under all sheet asphalt surfaces, including the fine mixture asphaltic concrete or "Topeka" specifications, are acting in accordance with what actual practice has demonstrated to be the most standard forms of street pavement construction.

It has been my experience with the above type of wearing surface that creeping and shoving will take place even under moderate traffic unless a binder course is used. The binder not only prevents this displacement, but adds support and stability to the wearing surface, which, owing to its composition being mostly sand, does not have the traffic resisting qualities within itself.

The value of the binder course was brought out very clearly in a paper read before the American Society of Municipal Improvements at Dallas, Texas, by Mr. Isaac Van Trump, engineering chemist of Chicago, in which he says, in effect: "On streets where traffic is medium to heavy, sheet asphalt pavements or even the fine stone asphaltic concrete wearing surface now being laid in many localities, will frequently creep and shove alarmingly when laid without a binder course."

The committee appointed by the League of California Municipalities to make a study of the best practices in pavement and roadway building made an exhaustive study of the merits of the binder course and reported strongly in its favor for this type of wearing surface referred to, and so it seems to me that the practice of eliminating the binder course in asphaltic pavements in order to slightly reduce the first cost of the pavement, is one that is not in accordance with the best practices in street pavement construction.

F. N. BINGHAM,
Engineering Chemist, Portland, Ore.

Graders for Road Work

The Editor of MUNICIPAL ENGINEERING:

Sir—The one most important township road-building implement is the grader, as its regular and proper use enables commissioners to not only make good highways at a reasonable cost but to maintain them and keep them in as good as new condition at a low expense.

The making and keeping of a proper crown is, as a rule, not given close consideration. After grading the road a long time the center of the highway may become too full. This condition has not been reached generally, but it may be. It is then time to turn the grader and throw the dirt from the center towards the edges.

A roadway well drained at the sides and treated with the grader consistently, faithfully and scientifically will never get very bad. It will be excellent to drive over eleven and one-half months of the year.

If all the money that is spent on the drag to the detriment of the road was put into grading there would be a great improvement in the highways. Because a township has many drags on hand is no

reason or excuse for using them to tear up and ruin roads.

A perfect dirt road can't be made with a grader in a day or a week, and scarcely in a year, but long and consistent use of it is bound to make a good road finally. The main trouble now with the grader is that it is used only spasmodically in many cases and then not at the right time.

We use traction reversible road machines very extensively in ditching, grading and trimming. These machines are operated by one man and are made by the Russell Grader Mfg. Co., of Minneapolis. We have been using horses for motive power thus far, but will undoubtedly operate traction engines this spring, as we expect to clear about ten miles of road and put in necessary ditches, bridges and culverts. The average grading will be in the neighborhood of twenty-eight feet thruout.

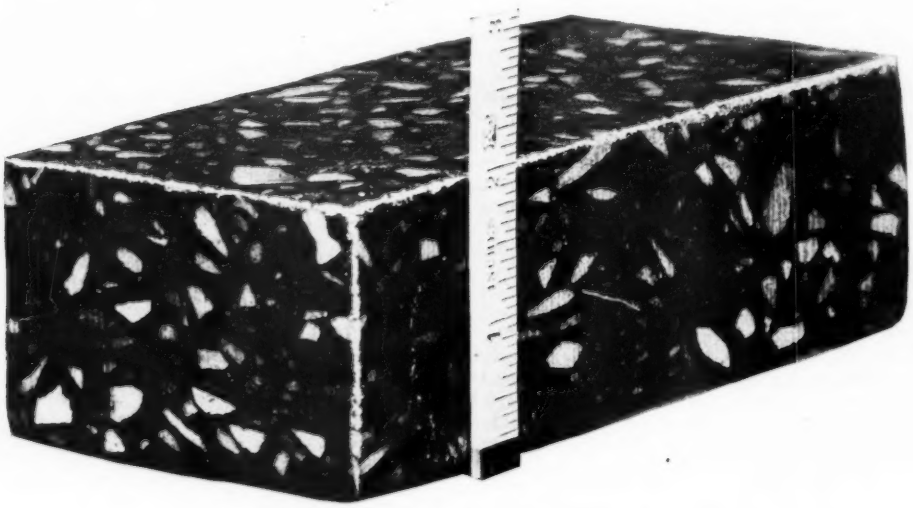
C. H. BORGSTROM,
Lima Township, Remer, Minn.

Asphaltic or Bituminous Concrete Pavements

The Editor of MUNICIPAL ENGINEERING:

Sir—We are inclosing herewith a photograph of section of stone-filled bituminous or asphaltic wearing surface, cut from the concrete foundation on Greenfield avenue, in Milwaukee, and rubbed down on a marble rubbing bed, this pavement having been laid by the Socialist administration of Milwaukee in 1911. It shows very clearly the texture of the pavement surface.

To those who are rather familiar with the old type of 2-inch asphalt wearing surface laid on a 1-inch binder, it might be said in explanation that if the 25 per cent. or so of crushed stone were removed from the pavement shown in this picture and laid in a separate course under it as a binder course, you would then have the old standard type of binder and top wearing surface.



SECTION *of stone-filled asphaltic wearing surface.*

AMOUNT AND COST OF INGREDIENTS OF BITUMINOUS WEARING SURFACE MIXTURES.

	Ashpaltic cement 1c per lb.	Stone dust 0 15c per lb.	Stone, ½ or 1" 0 05c per lb.	Sand 0.028c per lb.	Total materials
Stone filled 2 in. thick, lb. per sq. yd.....	18	22	50	110	200
Cost cents per sq. yd.....	18	3.3	2.5	3.1	26.9
Bitulithic 2 in. thick, lb. per sq. yd.....	15	10	125	50	200
Cost cents per sq. yd.....	15	1.5	6.25	1.4	24.15
Straight sand 2 in. thick, lb. per sq. yd.....	22	28	none	150	200
Cost cents per sq. yd.....	22	4.2	none	4.2	30.4
Binder course 1 in. thick, lb. per sq. yd.....	5	none	75	none	80
Cost cents per sq. yd.....	5	none	3.8	none	8.8

We are also inclosing a cost data sheet regarding asphalt and bituminous pavements on concrete foundation of various kinds.

The lowest bid that we received was from John W. Davitt, of Troy, N. Y., who has submitted a sample of Montezuma, Mexican asphalt, supplied by the Warner-Quinlan Co., who bid the following prices:

2-inch stone-filled sheet asphalt wearing surface, per square yard	$ .65
8-inch 1:3:6 Portland cement concrete foundation, per square yard	.70
5-year guarantee bond, per square yard	.05
Total for paving proper	$1.40
Grading, average 8-inch sandy loam, per square yard	.16
Granite curb, 6x12-inch, set in concrete and backed	.80

Needless to say, we intend to lay about 200,000 square yards of stone-filled asphalt wearing surface in spite of the injunction that has been issued against us to prevent our awarding the contract to the lowest bidder. We expect to receive even lower bids on April 2 for this work.

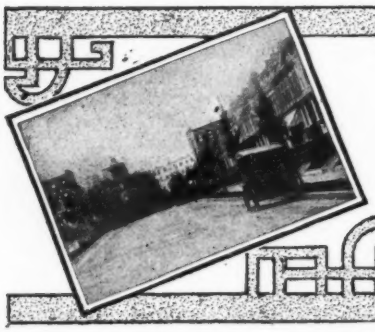
We are doing extensive sewer work; are about to reorganize and substantially reconstruct a very dilapidated water works system that supplies us with probably the best water any city can possibly have; besides which, we are engaged in city planning—about to build a public market, comfort stations and five model schools, and a garbage reduction plant.

C. A. MULLEN,
Superintendent of Public Works.

DETAILED COST OF ASPHALTIC PAVEMENTS OF VARIOUS MIXTURES.

	Stone Filled	Bitulithic	Course Binder	Sand Straight
Materials for mixtures at plant, from above table	$0.269	$0.2415	$0.304	$0.088
Fuel at plant, per sq. yd.	.004	.004	.044	.002
Labor at plant, per sq. yd.	.04	.04	.04	.02
Repairs at plant, per sq. yd.	.005	.005	.005	.003
Tools and sundries at plant	.01	.01	.01	.005
Cost per sq yd. for mixture at plant	$0.328	$0.3005	$0.363	$0.118
Hauling from plant 1 mile to street	.021	.021	.021	.01
Labor laying and rolling	.05	.05	.05	.03
Asphalt cement for paving gutters	.001	.001	.001	.....
Tools and sundries on street	.01	.01	.01	.005
Cost of mixtures per sq. yd. laid on street	$0.41	$0.3825	$0.445	$0.163
Guarantee bond running 5 years, per sq. yd.	.05	.05	.05	.01
Supervision, management and office charges, per sq. yd.	.07	.07	.07	.015
Cost of wearing surface proper	$0.53	$0.5025	$0.565	$0.188
Binder course, per sq. yd.	.....	.....	.188	.....
Comparative cost of wearing surfaces, per sq. yd.	$0.53*	$0.5025*	$0.753†	.....
Grading, per sq. yd.	.07§	.07‡	.075**	.....
Concrete, per sq. yd.	.55††	.55††	.55††	.....
Total cost of pavement, complete, per sq. yd.	$1.15	$1.1225	$1.38	.....
Legitimate profit of 10 per cent. per sq. yd.	.11	.11	.11	.....
Reasonable bidding price for competing contractors	$1.26	$1.23	$1.52	.....

*For 2-in. surface.
†For 2-in. surface and 1-in. binder.
§For 8-in. average grade.
‡For 2-in. average grade.
**For 9-in. average grade.
††For 6 inches of 1:3:6.



ROADS AND PAVEMENTS

Samples of Standard Pavements for Washington.

The many paving companies operating in the Northwest, and particularly in Washington, are building a road for the State of Washington.

By spring, the thorofare, which is going to form a link of over a mile in the International Highway, known as the Pacific Highway, should be completed and tho the paving companies are spending thousands of dollars to complete the road, all agree that it will not only advertise each company far in excess of their expectations, but that by giving this practical demonstration, their work will be subject to a fair and impartial inspection on the part of all municipalities or county boards of the state, contemplating using paving materials.

The idea first originated with the Olympia Chamber of Commerce, the organization of the capital city which sees that there is something doing all the time while the legislature is not in session, but so many requests have been received that the entire project has been practically turned over to the state highway department.

Secretary H. L. Whiting, of the Olympia Chamber of Commerce, wrote ten paving companies doing business in the Northwest, outlining the plan to them, which was as follows: The companies were each to construct a unit of paving, at least 100 feet long and 16 feet wide. Specifications are to be filed with the state highway department and the pavements are to be laid under its inspection; the highway commissioner, W. J. Roberts, in turn to keep the specifications, together with the reports of the inspectors, on file for the benefit of inquirers in years to come. Without a single exception the companies were enthusiastic over the plan and tho the frost is not entirely out of the ground several companies are now at work building their units.

The Chamber of Commerce of the capital city has written to every city council and board of county commissioners in the state, calling their attention to the construction of the highway and inviting them to inspect the different materials and pavements made with them. It is argued that the governing body of the city or county will be able to judge advisedly as to the merits of the different kinds of materials in use and will be able to adopt certain kinds for their cities or new districts to be improved.

In five years from this season, the "demonstration highway," as it is already known thruout the state, will be of more value from a test standpoint than it is today, when the paving is being laid just outside the city limits of Olympia, between the capital city and the suburb of Tumwater, where traffic is heavy.

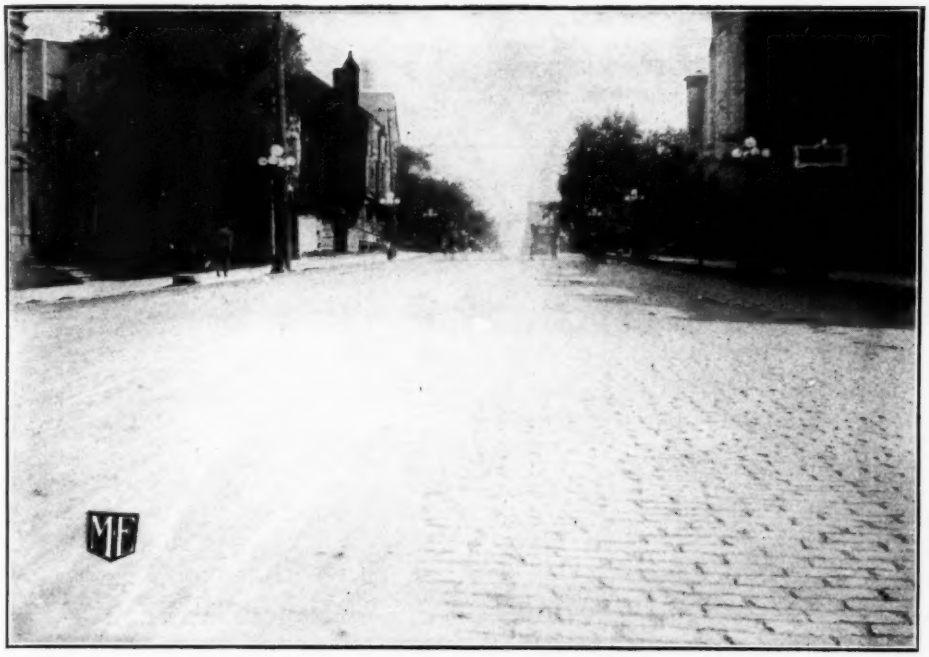
Being on the Pacific Highway, which starts at Vancouver, B. C., and ends in Mexico, running the entire length of Washington, Oregon and California, the demonstration road will be traversed annually by thousands from all parts of the United States, and arrangements have been made with the abutting property owners for the different companies to erect signs opposite their units, calling attention to the portions constructed by them.

The State of Washington, unless vetoed by the governor, is going to spend approximately $8,000,000 for primary highways this year and the plan now contemplated is to hard surface the Pacific Highway from the Canadian line to the Columbia river.

Bituminous Surfaces on Brick Pavements

The city of Minneapolis, Minn., has been experimenting with bituminous surfaces on brick pavements with results which are quite interesting altho the first experimental pavement is not yet a year old.

The first of the accompanying photographs shows Nicollet avenue brick pavement, which, between Tenth and Thir-



NICOLLET AVENUE, *between Twelfth and Thirteenth Streets, Minneapolis. Old brick paving covered with asphalt in the spring of* 1912.

teenth streets, was laid in 1898 using a sand filler. It will be seen from the appearance of the bricks on the right half of the picture that the pavement shows little wear, except that the edges of the brick have chipped considerably. In a paper before the American Association for the Advancement of Science, Ellis R. Dutton, assistant city engineer, attributes this chipping to the use of power flushers for cleaning the streets, the sand joints being washed out, leaving the edges of the brick unsupported against the hammer of travel.

The improvements in the manufacture of asphalt fillers, so that the adhesion to brick surface is increased, at the same time that the melting point is kept high, led to the consideration of such asphalt, not only to fill the troublesome joints in the old pavement but to coat it, thus making the street less noisy and preventing further chipping. Half of the block of Nicollet avenue between Twelfth and Thirteenth streets was thus treated in the spring of 1912, and the appearance of the treated half is shown on the left in the photograph referred to. The surface and the joints were thoroly broomed and dried and the asphalt was then applied hot, about a half gallon per square yard. The asphalt surface received a thin coat of coarse sand.

The asphalt adheres to the brick very well in general, but has not adhered in some places, so that the appearance of the street is not all that could be desired. The coating does not become excessively soft under a hot sun, is not brittle from cold, reduces the noise, and increases the foothold for horses.

The asphalt used in this experiment was rather low in melting point and penetration, as may be seen from the first column of the accompanying table, prepared from data given in Mr. Dutton's paper, above referred to.

Bituminous Coat on New Pavements

Bituminous fillers have been used for brick pavements constructed in Minneapolis since 1906, and pavements in which they are used are cleaned with the power flushers without injury. The apparent success in surfacing the old brick pavement with the thin asphaltic coating last spring suggested the same treatment for new brick pavements, so about double the amount of asphaltic filler usually required was applied, about 10 pounds per square yard, and the filler was spread over the surface as well as run into the joints. The labor cost was enough less than that required for the old method of filling joints only, so that it offset the increased cost of asphalt, keeping the total cost of the pavement the same as under the old specification. About 38,000 square yards of new brick paving have received this treatment during the past season. The

second of the accompanying photographs shows Marshall street and Thirtieth avenue, N. E., a new brick street in process of filling and coating.

MARSHALL STREET AND THIRTIETH *Avenue, Northeast, Minneapolis. New brick paving filled and coated with asphalt in* 1912

The asphalt used was somewhat heavier than that on Nicollet avenue as will be seen from comparison of the analyses of the two given in the accompanying table.

ANALYSES OF ASPHALTS USED IN COATING MINNEAPOLIS BRICK PAVEMENTS.

	Old brick, Nicollet Ave.	New brick, 30th St.
Specific gravity, 77 deg. F.	0.980	0.9885
Melting point, Am. Soc. C. E., deg. F.	117	....
Melting point, ball and ring, deg. F.	...	180
Melting point, Gen. Elec., deg. F.	...	183
Penetration, 32 deg. F.	60	46
Penetration, 77 deg. F.	175	67
Penetration, 77 after heating	...	58
Penetration, 115 deg. F.	...	122
Flash, deg. F.	...	536
Burn, deg. F.	...	580
Loss, 5 hrs., 325 deg. F., per ct.	2.4	0.04
Soluble in carb. di-sulph., per ct.	99.7	....
Soluble in 88 deg. B. naphtha, per cent	75.5	....
Soluble in carb. tetrachl. per ct.	...	99.6
Organic matter insoluble, per ct.	0.2	....
Ash, per cent	0.1	....
Fixed carbon, per cent	7.8	11.62

Mr. Dutton thinks that the quality of bituminous material for this use could be improved by manufacturing it expressly for such duty so as to produce a maximum of adhesive strength without unduly increasing brittleness in cold weather or the tendency to soften under a hot sun. The bituminous surface will wear off but it can be renewed for a small cost per square yard and the bricks themselves are protected from wear if such renewals are made promptly. As in any bituminous work the surface must be thoroly clean and thoroly dry and the work must be thoroly done.

Road Building in Oregon

By Helmus W. Thompson, County Judge, Eugene, Ore.

An interesting experiment in the dissemination of good roads ideas is being tried at Eugene in Lane County, Oregon. In Oregon the unit of road administration is the county, which is divided by the County Court into road districts, in each of which the Court appoints a road supervisor. The road supervisors are under the control of the Court and may be discharged for disobedience. The officers having road matters in charge are the County Judge and two County Commissioners. It seemed to these officials that it would be a good plan to spread more widely the instruction afforded by the Federal Office of Public Roads. Thru the courtesy of this department and Mr. Logan Waller Page, its very efficient director, there were sent to the County Court five road models; one of a dirt road, one of a gravel road, one of a water bound macadam road, one of a bituminous macadam road, and one illustrating drainage. These models are three feet by five feet, and are the same as the ones included in the United States exhibit at various expositions. Every road supervisor gets into the Court House a number of times during the year and fully one-half the ranchers of the county come to the Court House during the year. It is impossible for them to come into the County Court

House without noticing the models, and the County Court explains the models to them and tries to impress them with the correct principles of road building.

We have only had them for two months, but I have no hesitation in saying that the scheme is successful and that it could be used with advantage thruout the country.

In addition to the road models the Court has models of the Little Western graders used by the county and sample of the American ingot iron metallic and concrete culverts used.

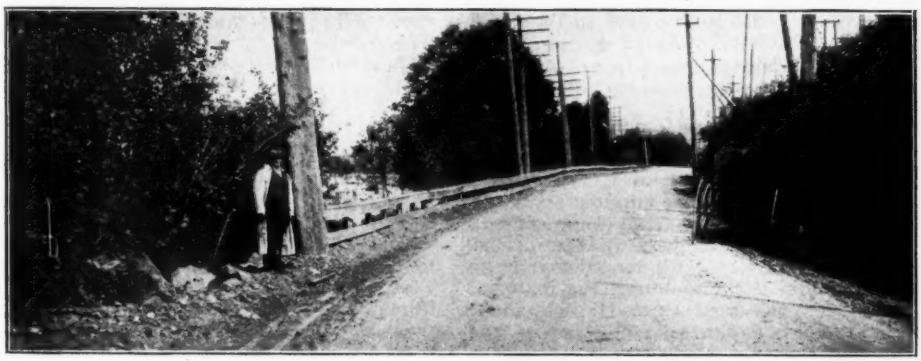
Recently a convention of road supervisors was held in Eugene and these models were of great benefit in instructing the supervisors and many others who were present.

Lane County will be crossed by the Pacific Highway and this county has already 16 miles, more than a quarter of the distance, laid in water bound macadam or better, and further work will be pushed during the coming season. In addition to this macadamizing work there have been laid on the highways of Lane County 52,000 yards of crushed rock and gravel in the past year.

Early in the past year the County Court adopted the policy of building well a few miles of road each year. Repairs are made every summer by the different road districts. The County Court employed a competent road supervisor to have general oversight over all road construction in the county, advising the district road supervisors, and recommending to the County Court the improvements that he deemed necessary. More particularly, however, the superintendent has charge of macadamizing work, of which seven miles were completed last year in sections adjacent to each of the larger cities.

The county has purchased modern equipment, including a score or more of road graders, auto trucks for hauling crushed rock, rock crushers and heavy road rollers. The graders are sent to the various districts where there may be demand for them, but the heavier machinery is used for the greater part in the macadamizing operations.

Something new in road work this winter was the employing of men to patrol a section of stage road in the western part of the county. These men are to go over certain sections of the road constantly, remove rocks, drain mud holes, and in other ways keep the roadway in repair. If the results in easier winter travel and in preservation of the roadbed justify, the patrol system will be extended, or at least for the winter months, when Oregon rains usually do the most damage to the roads.



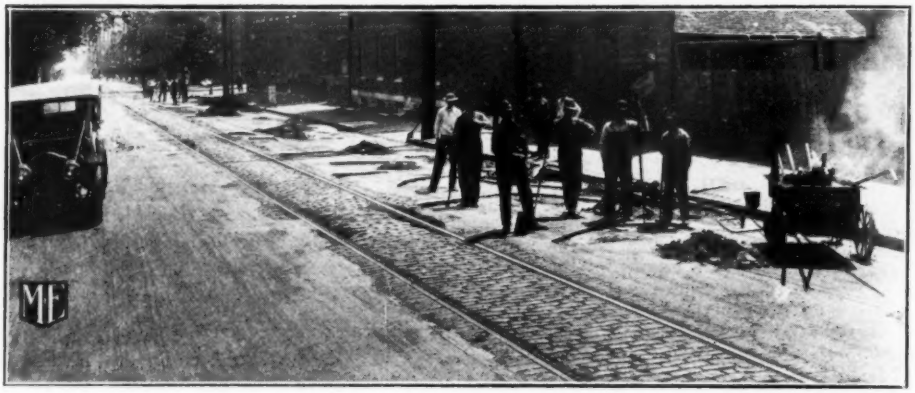
MACADAM ROAD NEAR EUGENE ORE., *part of Pacific Highway.*

How to Repair Asphalt Pavements

By W. L. Hempelmann, Engineer Bituminous Roadways, St. Louis Street Department; Member Illinois Society of Engineers

Everyone interested in the maintenance of bituminous pavements is familiar with the asphalt patching gang, the necessary equipment and the manner in which repairs are made. "Cutting out and plugging in," as the most common means of repairing an asphalt or bitulithic pavement is termed, is most generally used. To do this properly and satisfactorily requires more attention to details than the casual observer would believe. Trimming the joint, properly painting same, tamping or rolling the hot asphaltic top mixture of the desired consistency into the prepared depression, is the general procedure. The accompanying photograph shows the process, except that the roller is absent. A careful examination of such a pavement where patching, as described, has been done, will frequently reveal the fact that the joint between the patch and

the old pavement has not been sealed, due perhaps to what is known as a "dirty joint," but generally to carelessness on the part of the laborer in not painting every part of the exposed edge of the depression. This condition is easily observed when, after a rain, the sun has dried up the surface of the pavement, while the patches are definitely outlined by a wet line. Another source of trouble comes from the pushing or displacement of patches because of the material used. The patching material should be as nearly as possible of the same consistency as the old pavement, that when the summer's sun warms up the pavement, the old and the new material may soften to the same degree. The folly of using a new street mix as patching material in an old pavement has frequently been exemplified.



ASPHALT REPAIR GANG *at work on a St. Louis street.*

Surface Heater

A temperature variation from five or ten degrees below zero to 120 or 130 degrees Fahrenheit in the summer's sun, on the surface of the pavement, presents a complex problem concerning the proper mixture to be used. Under slow moving heavy loads in the summer, the material is apt to push or creep, bringing about a wavy or undulating condition of the surface. Such a pavement is very "bumpy" to the automobilist. This condition can frequently be remedied by the use of surface heaters. By this means, the bumps or high places are softened and all the burned and soft material is scraped off, leaving a clean surface of the old material. Such burning should be continued until the burned area will require at least one inch of added material to restore the pavement to its proper surface and cross-section. In almost every case, it is well to cut a joint at the edge of the burned area, an inch or an inch and a half deep, that the edge of the old pavement may serve as a shoulder for the new material. The surface of such burned area should be made as rough as possible, using a pick or the point of a hoe, that the old material may serve as a key to hold mechanically the new material in place. The whole area should be liberally sprayed or sprinkled with an adhesive asphaltic cement, to bring about a better union between the old surface and the new material. This method is economical and when properly done, gives entire satisfaction. Our records show that this method of making repairs, including labor, material, roller and fuel, costs from fifty cents to fifty-five cents per square yard, depending upon conditions, while straight patching in the ordinary way costs from seventy-five cents to ninety-five cents per square yard.

Joints Must Be Waterproof

Here, again, it is absolutely necessary that the joint between the old and the new pavement be waterproof for the best results. The effect of an imperfect joint or not properly sealed joint is best seen in the late fall or early spring of each year, when, by alternately freezing and thawing, the moisture in the joint tends to separate the patch entirely from the rest of the pavement. Such a joint, once opened up during the winter, will not heal in the summer under traffic, the dust from the surface finding its way into these small crevices and preventing for all time the amalgamation of the two mixtures.

In the case of larger stone mixtures, it is this open surface condition, which permits moisture to freeze and thaw in the surface, that materially aids in pitting of the surface. Steel tire traffic on such a wet, open surface is much more detrimental, in that the steel grinds or crushes the surface rock much more readily because of the better "grip" it gets on

same. In the case of mixed traffic, motor and steel tired, the suction, created by the rapid motion of the former, tends to redistribute these fine particles. This can be seen when, after a heavy shower, the fine material from the surface can be found at the low point in the grade.

Waterproofing the Surface

Recognizing water as one of the worst enemies to smooth pavements, we have endeavored to waterproof our asphalt and bitulithic pavements by treating the surface. Flush-coating or squeegee-coating the last-named pavements has generally been done, as a matter of course, to "seal the surface." Hand squeegee carts or pressure wagons to evenly distribute the bituminous material with a coating of sand are generally used. In recent years, the economy of flush-coating the bitulithic streets under contract maintenance is evidenced by the fact that a flush-coat gang is one of the regularly equipped maintenance gangs when repairs are begun after the winter. This thin coat on the surface performs a double duty. It tends to waterproof the surface, by filling all the surface voids, and with the sand, forms a thin cushion coat on the surface, taking the wear off the pavement proper. In other words, we tend to build up the pavement by the judicious application of flush coats, rather than permit the pavement to wear down under traffic. Under our traffic conditions, such a flush coat wears at least a year. Using tar at 7¼ cents per gallon and applying same by means of pressure wagons, our total flush-coat cost on bitulithic pavements this summer, including tar, sand, teams and labor, was about 2½ cents per square yard.

In the case of asphalt pavements, we applied the same reasoning. We have oiled some of our asphalt pavements and covered same with sand at a cost of about one cent per square yard, for material, covering and applying. An old pavement in this case, it was thought that the oil treatment would help keep the water out of the pavement and, at the same time, tend to give new life to the bitumen in the pavement. This thin cushion coat on the surface plays an important part in the wearing of such pavement during the winter months, when chains are attached to the driving wheels of the automobile, the pounding having the same effect as so many trip-hammers passing over the pavement. This thin layer on the surface largely takes care of this added wear.

Bituminous Surfaces for Roads

Bituminous surfaces for roads are neatly classified by Arthur W. Dean, the Chief Engineer of the Massachusetts Highway Commission, in a paper before the American Association for the Advancement of Science. The treatment of a road surface with an oil emulsion serves as a dust layer and does not form a distinctive part of the wearing surface of a road. A bituminous surface of appreciable thickness may be formed on top of a road crust by the application of one or more coats of bituminous material, with gravel, sand, or stone chips added. This is called a bituminous carpet surface. If the bituminous surface approximates 2 inches in thickness it can no longer be termed a carpet, but rather becomes an integral part of the road crust or pavement.

Oiled Macadam

The first class is hardly a bituminous surface, for it is produced by adding a small amount of light oil to the road dust to prevent its removal by the wind and by traffic. This serves the same purpose as sprinkling with water, but is better, because the physical characteristics of the oil cause it to do the work required better and to retain its effect longer. This oiling does not improve the wearing qualities of the road very much beyond the effect of retaining the material on the road surface and thus covering the road material below. Heavy oiling and addition of dust and sand may make this class of road surface approach the second class, which Mr. Dean terms the bituminous carpet. The first class is a cheap treatment suitable only for light travel and for temporary purposes and requires frequent renewal.

Bituminous Concrete

The third class includes the best grades of bituminous surfaces, beginning even with asphalt and bitulithic pavements and continuing down thru the various forms of bituminous concrete and bituminous macadam, produced by mixing the road materials with the bitumen before laying, and, perhaps, some of the best road surfaces produced by the penetration method. Such road surfaces are expensive and can usually be afforded only on the roads of heaviest traffic in the vicinity of large cities where property valuations are high enough to raise the necessary money without making the tax rate excessive.

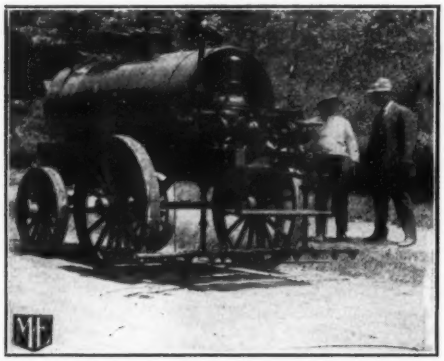
Bituminous Carpet

The second class, Mr. Dean's bituminous carpet, is of the most general application to country roads, being in some form or other of sufficient stability to keep its place under the traffic to which it is subjected, and low enough in cost to be within the means of the districts in which a surface of this class is desirable and economical of maintenance. The quality of the surface may vary from something not much better than the best

oiled surface, tho only the heavier asphaltic oils are used, almost up to pavements suitable to city streets.

Good Foundations Necessary

The first requirement is a good foundation, something which is likely to be neglected in this country. Many bituminous carpet surfaces which have failed would have been successful and economical if the foundation had been sufficient. The road crust or carpet cannot sustain any load if there is a failure below and in such cases is immediately cut to pieces. For average traffic on suburban roads Mr. Dean considers a water-bound macadam road on a suitable and sufficient foundation as an ideal crust on which to apply a bituminous carpet. With heavier traffic or treacherous foundations a cement concrete crust will be even better, but a carpet of asphaltic nature will not adhere to it as one in which tar is used. A good gravel road will serve for light traffic, but does not hold a carpet made with heavy asphaltic or tar binders unless the carpet approaches the third class in thickness. The bituminous binder used should not require heating beyond 100 deg. F. before application, as distinguished from heavy binders requiring heating to 180



PRESSURE DISTRIBUTER *of tar for bituminous carpet.*

deg. F. or more. A dirt road cannot be used as the base of a bituminous carpet, as it breaks up under any kind of traffic.

Laying the Carpet

The carpet must be uniform in thickness, the grit being spread uniformly and the tar applied under pressure, so that it will also be spread uniformly and will penetrate thoroly. The best results are obtained by using, first, coarse material, consisting of tough pebbles or stone broken approximately to half-inch diameter, followed immediately by finer material, such as sand or a coarse grade of stone dust. This produces a good mixture of the two materials and gives better results than either the fine or the coarse material alone, especially if there is much hard-tire traffic. Assuming a half-gallon of tar to be required per square yard, more uniformity is obtained if it is applied in two coats of a quarter-gallon each, each layer of bitumen being covered with grit immediately after application. The grit should be clean—no clay or loam.

Under mixed traffic—trucks, automobiles, heavy and light horse-drawn vehicles—the asphalts requiring temperature of 200 deg. F. or more to melt into condition for application give better results than lighter bitumens, according to Mr. Dean. But if the traffic is largely heavy steel-tired vehicles, the lighter bitumens give better results, the tendency of the heavily loaded tires being to cut the carpet and cause it to crumble if the asphalt is not flexible.

How to Choose the Right Method

The character of traffic has everything to do with the choice of the kind of road surface and Mr. Dean is quite as strong an advocate of the traffic census and comparison of road conditions as are the editor of MUNICIPAL ENGINEERING and nearly all prominent road engineers. Mr. Dean gives, in the paper above referred to, some examples of the action of traffic on roads which warrant this stand. He says:

"It has been demonstrated that a tar carpet will carry economically 100 automobiles per day per foot in width of roadway, together with a horse-drawn traffic of 15 vehicles per day per foot in width of roadway. On the other hand, a similar tar carpet failed under a traffic consisting of 20 heavy horse-drawn, steel-tired vehicles per foot in width of roadway per day, with only 8 automobiles per foot. This clearly demonstrates that a tar blanket is not suitable and should never be used to sustain heavy horse-drawn traffic, but is suitable and economical in carrying automobile traffic. Inasmuch as no particular wear appeared to be caused by the above mentioned automobile traffic, it is safe to assume that a much larger traffic could be economically carried. Records kept by the writer show that what has been stated above regarding the tar carpet is true also of the heavy asphaltic oil carpet. Failures that have occurred under the writer's observation with a heavy asphaltic oil carpet have occurred where the ratio of the number of automobiles to the number of horse-drawn vehicles was not any greater than two to one, and if the horse-drawn vehicles are of the heavy two-horse type, with narrow tires, no amount of automobile traffic appears to be sufficient to counterbalance the destructive effect of 15 heavy horse-drawn vehicles per foot in width per day.

Mr. Dean is of the opinion that it is not wise at the present time to state general positive conclusions regarding limitations in the use of bituminous carpet surfaces. Such surfaces have been in use in this country only about four years, and the character and quality of the bitumen used at various times and in various places are so unequal, and the character of traffic over the highways is and has been changing so rapidly, that the results of experiments and observations have been variable. Positive and definite conclusions as to limitations can only be drawn after careful observation through a period of years, keeping a record of the kind and quality and amounts of material used in the carpet, and of the kinds, number and approximate weights of vehicles passing over the sections under observation.

Asphalt Must Be Tough

The toughness of the bituminous material to be used in treating road surfaces has been studied by J. E. Myers, the chemist of the New York State Department of Highways, and he presented some of his results in a paper before the A. A. A. S., at its recent convention.

He says that in 1909 about 200 miles of asphalt-bound macadam were constructed, using asphalt with penetration 225, and there was much complaint of "bleeding" the next summer, requiring additional grit on the surface, which did not always consolidate with the old surface, and became loose, wavy and easily rutted.

In 1910 the penetration requirement was reduced to 120 and the quantity used was slightly reduced. Some of the 435 miles of these roads raveled badly or broke up in the following winter. Examination showed that the asphalts all had about the same chemical qualities, but those used in roads which were in good condition were less susceptible to the weather, more tough, less brittle, than those used in the roads which raveled.

A test for toughness was then devised, dropping a weight on a ball of the asphalt at 32 deg. F. temperature, the measure of toughness being the drop in millimeters necessary to rupture the ball, the test being that of the American Society for Testing Materials for toughness of macadam stone, with the addition noted above.

In 1911 the penetration of the asphalt was increased to 160 and a toughness of at least 15 was secured. Of the 500 miles laid that year, there were no failures from brittleness of asphalt. The same is true of 1912.

The conclusions reached at this time are that any binder with toughness at 32 deg. F. less than 15 is not safe, especially for the penetration method; that toughness of 15 to 25 does not give a large factor of safety, but will not give trouble unless the roads are built late in the fall and not consolidated before freezing weather begins; and that asphalt of toughness of 25 or more will not give trouble from brittleness under any ordinary conditions.

Improvements in St. Joseph, Mo.

By Charles W. Campbell, City Engineer.

More than five miles of paving was laid in St. Joseph during 1912, including streets and alleys, at a total cost of $151,543.52. This paving was done at a smaller cost than was paid for only four miles laid in 1911, the tax bills for that year's work having totaled $152,342.28. Thirty-four paving contracts were completed within 1912; work on six is in progress at this time; proposals have just been received for seven jobs; eight are ready to be advertised; five are pending in the council; fifteen are in course of preparation in the engineering department, and nine jobs are before the board of public works.

Almost three and one-half miles of grading was done in 1912, at a total cost of $16,418.15. Twenty grading jobs were completed; two are in progress; four are ready for advertising; thirty-three are in preparation in the engineering department; eleven are pending in the city council; fourteen are in legal progress; five are tied up in the city treasurer's office, and one is before the board of public works.

Eight sidewalk jobs were completed within the last year, at a cost of $11,962.74. Only six jobs were done during the preceding year, at a cost of $870.70. Bids recently were received on two sidewalk jobs; ten propositions are in the engineering department; one is before the council, and two are before the board of public works. The sidewalk record is considered an unusually good one, and the year's work marked the inauguration of a campaign for artificial stone walks on all the principal streets of the city. Almost two miles of concrete walks were laid on Ashland avenue last year.

Practically four and one-half miles of district sewers were constructed during 1912, costing $33,081.72. Thirty-four sewers were completed; seven are building; bids on seven sewers have just been received; eleven are ready for bids; twelve are in the engineering department, and four are pending in the council.

Four main sewers were built at a cost of $33,000, and three are in course of construction. A proposition for another extention of Blacksnake main sewer from Wallace street to New Ulm Park has been started.

The total amount expended for im-

provements completed during 1912 was $246,006.13 for 100 jobs.

The street department expended $18,784.38 as follows:

Flushing streets	$3,014.62
Sweeping streets	6,633.75
Work on dirt streets	7,293.19
Cleaning gutters	1,842.62

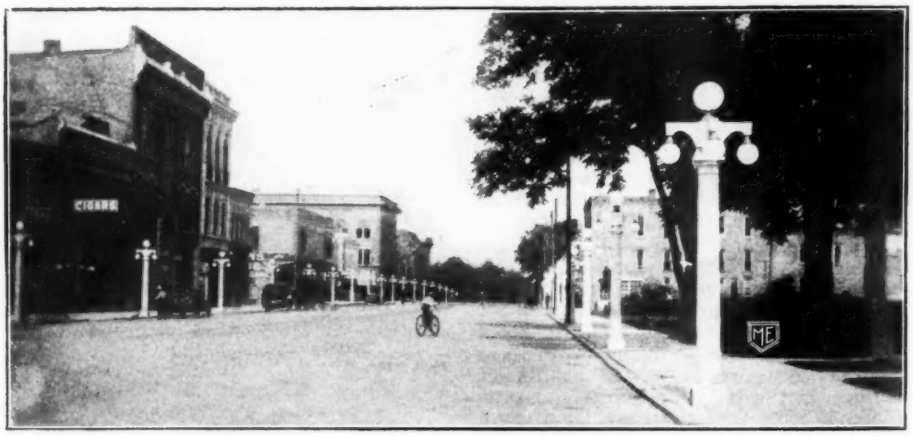
Extra work done during 1912 included the following improvements, with cost of each:

Stairway at Fleeman street	$210.00
Brown's Branch ditch	715.77
Huntoon street bridge	445.00
Bridge at 3rd and Valley streets.	367.00
Bridge at 2d and Atchison sts	385.00
Hose house No. 1, Fourth street near Charles	8,668.90
Hose house No. 16, 33d street and Mitchell avenue	5,617.35
Hose house No. 15, 4th and Sycamore	5,519.10
Repairs to paved streets	4,757.31

Motor Traffic Requires Heavier Foundations in London Boroughs

The Metropolitan Committee on the Materials and Means of Paving the Streets of London received a number of replies in response to an inquiry whether motor traffic has had the effect of increasing the cost of paving and maintenance. In most cases the answer is in the affirmative. Many surveyors report that they are finding it necessary to increase the depth of the concrete foundations. In Bermondsey, for instance, while concrete 6 inches deep was formerly sufficient, the depth is now being made 9 inches or even 12 inches. In Hackney foundations which were sufficient a few years ago are now found quite inadequate and in new work the concrete is being made 50 per cent. thicker. The Hampstead surveyor considers that the life of wood paving has undoubtedly been reduced by one or two years, and it has become necessary to increase the thickness of the concrete foundations from 6 inches to 9 inches. In Holborn cement foundations 12 inches thick are being laid in places where a thickness of 6 inches was sufficient ten years ago. In Paddington concrete from 10 inches to 13 inches thick is being used on wood-paved carriage ways where the thickness was originally about 7 inches, and in Westminster the specification now used when new foundations have to be laid provides for 1 inch of floating and 8 inches of concrete foundation instead of 6 inches.

On the other hand, the Fulham surveyor states that motor traffic has had the effect, if anything, of decreasing the cost of maintaining wood-paved roads. It soon finds out weak spots and the immediate repair of these appears to increase the



STATE STREET, *Sycamore, Ill.*

A Handsome Street in Sycamore, Illinois

What can be done witth the main street in a small city is well shown in the accompanying photograph, for which we are indebted to Mayor J. D. Beckler.

State street, the main business street of Sycamore, Ill., is 100 feet wide, with 12-foot cement walks and an asphalt pavement 76 feet in width. There are 38 of the ornamental street lighting posts, spaced about 60 feet apart, 28 with 3 lights each, and 10 with 5 lights on the street corners. The columns are Pettyjohn reinforced concrete posts and the lights are 60-watt 110-volt Mazda. The concrete foundations of the posts are 24 inches square and 24 inches deep and they are connected by an underground simplex lead-encased steel-taped cable.

number of repairs; but the life of the wood-paving is considerably increased and more than compensates for the increased cost of repair. Scavenging also has been considerably reduced. On water-bound macadam roads in Fulham motor traffic has caused considerable damage and disintegrated the surface, but the roads so affected have been remade with bituminous macadam, with the result that the cost of maintenance of such treated roads now submitted to motor traffic is not more, perhaps less, than of the water-bound surface before motor traffic came upon it. In Finsbury the surveyor cannot say that motor traffic has increased the cost of road maintenance, and in Westminster, while the engineer is of the opinion that the increase of motor traffic prejudicially affects macadam roads and, perhaps to some slight extent, asphalt roads also, he does not think that, as a result of motor traffic, there has been any increase in the cost of maintaining paved roads originally laid on present approved methods. The Hammersmith surveyor considers that on wood-paved roads time will show decreased cost of maintenance, since the life of the wood will be slightly lengthened, but on all other roads the expense is largely increased.

The Movement for a Traffic Census on Roads

Recognizing the fact that more information is needed in determining the proper type of construction for any given section of road, the National Good Roads Board of the American Automobile Association is convinced that proper steps should be taken in every state in the Union to gather such data as will show the number, character and approximate weights of vehicles passing over the principal roads.

The failure of many roads to stand up under the traffic is due, not as many persons suppose, to inferior materials and workmanship, but to the lack of preliminary information as to the traffic the road was expected to stand. Consequently, roads have been built which would have lasted for years under other travel conditions; now they are ruins, due to the absence of data which the engineering profession in any other branch of their work would have considered essential. On this subject an authority says:

"Without knowing the wear a road has, there is absolutely no way of telling whether it is good or bad; only a careful traffic census can determine this. Roads too costly have been constructed in some places; in other places roads unsuited to the traffic have been built. In view of this well-known fact, it is evident that a traffic census is an essential to economy in nearly all road building. Imagine a bridge designer making plans for a structure without anything more than a rough guess whether it was to be used by steam railways or trolley cars, and we have an idea of the absurdity of proceeding with road building without traffic data."

Illinois, in 1907, caused to be enumerated the travel over the roads at a few important points, and in March, 1913, Highway Engineer Johnson writes: "I am sure we never collected any data on which I feel that I can place greater reliability than our traffic census data. It has been, all things considered, the most satisfactory investigation that we have attempted."

Massachusetts tried taking a traffic census in 1909, and went into the subject on a larger scale in 1912. In August and October, 1912, counts were made at 160 stations at different points in the state, each covering a full week of time, and twelve to eighteen hours a day, according to location. The results enable the Highway Commission to make plans for not only carrying the present travel, but also to provide for the increase that is bound to come.

It is considered, in view of the rapid changes in traffic and traffic conditions being rapidly and constantly made, that traffic census should be provided at least four times a year, of at least a week at each period, and should cover the principal roads entering every city in a state. To be of real value, the census should continue for a series of years, in order to establish a proper knowledge of the ratio of increase. After a few years, and the establishment of practical standards from which estimates could be made, so great frequency of count would not be necessary.

Provisions for traffic census in most states will require the enactment of special laws, and special appropriations. Compared with the saving which would be effected in road construction the expense would be trivial. The figures, when made and properly collated, would be the basis on which all highway planning would rest.

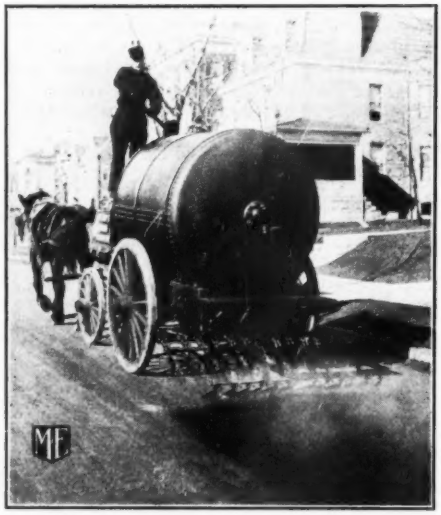
Sanding Wooden Block Streets

By W. L. Hempelmann, Street Department, St. Louis, Mo.

It has been the practice in St. Louis for the last three years to oil and sand the wood-block thorofares. This, largely, is a treatment for slipperiness, and was evolved gradually. Sand or sharp grit was first spread over the surface of such pavements.

Most of the sand was soon found in the gutters, blown to the side by the rapidly-

moving motor cars and by the wind. The benefit from such a treatment was very short lived. Next, oiled-sand was tried, the oil and sand being mixed in asphalt mixing pans and spread over the surface from wagons. This was slow, expensive and unsatisfactory, since the sand had to be heated and dried to mix the oil with same, and when this warm material was hauled to the street, the bottom of the load was extremely soggy because of the oil which percolated from particle to particle of sand and collected near the bottom. Spreading this soggy material uniformly was impossible. Then, at the suggestion of Mr. J .C. Travilla, Street Commissioner, the oil was sprayed on the



SPRAYING OIL *on wood block pavement, to be covered with sand.*

wood-block surface and covered with sand. This method proved very satisfactory and was economical, costing about one cent per square yard for oil, sand and labor. For this work we apply about one-eighth of a gallon per square yard, using a pressure wagon for distribution. Such a treatment lasts through the winter and largely helps to waterproof the surface. The accompanying photograph shows the oil sprayer at work.

Creosoted Wood Block Pavement in the Boroughs of the Bronx and Brooklyn, City of New York

"Our present practice is to lay long leaf yellow pine block only on those streets carrying the heaviest traffic," states Thomas W. Whittle, commissioner of public works, Borough of the Bronx, city of New York.

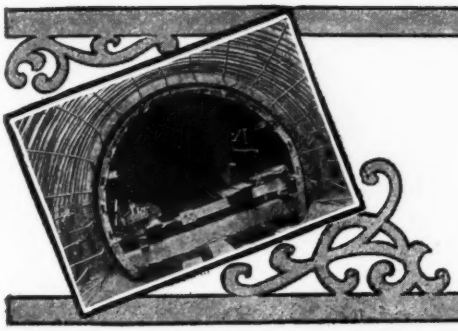
"There are plenty of pavements which are not good for heavy traffic streets, but we know creosoted wood block is and the heavier it is founded the better it wears and endures. The conditions of streets paved with wood block, as compared with other streets paved at the same time with the other types of pavement, are very favorable to the wood blocks. Aside from noiselessness of traffic, I should say that other advantages are that the pavement is sanitary, easily repaired and cleaned. With one exception the pavements thus far laid are still under guarantee. The exception referred to is Tinton avenue, where the upkeep cost for 1910 was 8 cents per square yard, and for 1911 9.1 cents per square yard.

"Blocks are laid with grain vertical. The cleaning of the streets comes under the jurisdiction of the street cleaning department. The work is done by sweeping and, under certain conditions, flushing.

"Creosoted wood block is laid in the following streets of this borough:

Name of street	Length paved feet	Sq. yds.	Date of completion
Brook avenue.....	548	5,170	12/26/07
Charlotte street.....	1,080	3,644	12/14/08
Lyman Place.....	542	1,785	11/16/08
Minford Place.....	1,349	4,541	11/16/08
Rogers Place.....	901	2,975	12/24/08
Southern boulevard..	8,794	70,338	4/13/08
Southern boulevard..	900	5,987	8/25/11
Suburban Place.....	281	917	11/10/08
Tinton avenue.....	2,415	8,102	8/ 4/04
E. 136th street.....	493	1,710	12/13/08
E. 154th street.....	171	455	12/ 7/08
Webster avenue.....	805	5,562	5/25/12
E. 158th street.....	244	655	4/27/12

"We use long leaf yellow pine creosoted wood blocks very extensively in this borough," states H. H. Schmidt, chief engineer, Borough of Brooklyn, city of New York. "This pavement is subjected to all kinds of traffic and we believe the maintenance cost is very low, everything considered. The maintenance cost of a pavement is a very important item. The first cost is undoubtedly less important than the upkeep and maintenance cost.



SANITATION

Sewage Disposal and Water Supply at Duluth, Minn.

By John Wilson, City Engineer, Member Minnesota Engineers' Society.

DULUTH discharges its sewage into Lake Superior, the largest body of fresh water in the world, and the source from which it takes its water supply, and it still has water of good quality.

The shore line of this city is about fifteen miles long, very steep and rugged, making the run-off very rapid and complete. The average temperature of Lake Superior being lower than that of Lake Michigan, disposal of sewage by dilution is more favorable than at Chicago, where the amount of dissolved oxygen in the water will necessarily be less. While conditions are very favorable for this form of disposal in Duluth, they are very unfavorable for artificial methods of treatment. During rainstorms the whole shore line is more or less polluted by the washings from barnyards, street gutters, storm sewers, cesspools, etc. A great deal of storm water is admitted to the sanitary sewers, which only tends to increase the difficulty of treatment. Then the difficulty of picking up all the various outlets along the shore, or of installing individual plants at each outlet would be considerable.

Septic Tanks Not Applicable

Septic tanks would be entirely out of the question, as each would tend to increase rather than diminish the nuisance at the various points, and as far as improving the bacteriological condition of the lake, the change could probably not be detected.

The most favorable method of treatment would no doubt be by the installation of Imhoff tanks, followed by calcium hypochlorite. The first cost of such a scheme would possibly be about $300,000, with an annual cost about as follows:

Payment into sinking fund to redeem bonds in 20 years, interest at 4 per cent	$10,074.00
Interest on first coat at 4 per cent.	12,000.00
Chemicals at 1½ cents per pound.	6,750.00
Labor and maintenance	10,000.00
Total	$38,824.00

This treatment might result in a removal of about 96 per cent. of the organisms, but there might still remain a "resisting minority" of about 150,000,000 in every gallon of the effluent. In time of storm, however, we could not expect to secure results as good as this. In addition, the pollution from the street wash, cesspools, barnyards, etc., would still give us quite a problem to deal with, and the protection offered by the sewage purification plants at such times would not be very great. Then, too, calcium hypochlorite, like all other forms of disinfectants, has its selective peculiarities, and it is quite possible that a great many of the organisms destroyed by its use are soon killed off, anyway, by natural causes shortly after reaching the lake water. It is quite evident that while we have accomplished considerable, as far as the sewer goes, very little has been accomplished as far as protecting the water supply is concerned.

Water Supply Purification Effective

Duluth's intake is several miles from where the greater portion of the sewage is discharged, and rarely is there any suspended matter in the water. The bacteriological count is very low, rarely exceeding, I am told, 25 per cubic centimeter. But colon bacilli have been found quite frequently in 100 c. c. amounts, and the water is now being treated with calcium hypochlorite at the rate of 0.13 part per million available chlorine. And this very small quantity removes about 75 per cent. of the organisms, leaving an average count of about 5 per c. c., and colon bacilli seldom present in 100 c. c. amounts.

The cost of the treatment is, of course, practically nothing, and consumers cannot detect the presence of the chemical.

If, in the near future, the increase in the pollution from all sources should be such that the above treatment would seem not sufficient to safeguard the city against infection, and it should be advisable to in-

stall a filter for the water, the first cost would possibly be about $300,000, with an annual cost as follows:

Payment into sinking fund to redeem bonds in 20 years, interest at 4 per cent	$10,074.00
Interest on first cost	12,000.00
Cost of chemicals	150.00
Operation	6,000.00
Total	$28,224.00

More than $10,000 per year less than that of treating the sewage, and with results that will not admit of comparison.

Duluth's attitude in this matter at present is the right one, the water is being treated as the amount of pollution demands; and as the city grows in the vicinity of the pumping station, care must be exercised that sewer outlets do not encroach on the intake. In the course of time conditions may arise, most probably along the bay, when it will be necessary to treat the sewage for the purpose of preventing a local nuisance. But not unless the science of sewage purification is wonderfully advanced over what it is today will it be for the purpose of protecting the water supply. The Royal Commission has but recently advised a repeal of England's present laws, and the adoption of standards for sewage purification more in accordance with the present possibilities.

Of course, there are many cases where sewage should be treated for the protection of water supplies, but the object should be to remove an overburden from the water purification plant, rather than take its place.

I do not wish to minimize in any way the importance of sewage purification; my purpose is to point out some erroneous ideas that are only too prevalent. The attitude of many in Duluth in advocating sewage purification in preference to the simple, yet efficient, treatment the water is now receiving, is a very common one. They think when we say purification we mean purification; whereas, the word is used in a comparative sense only, and does not imply purity either from a chemical or a biological standpoint.

While this matter has been discussed a great deal in our technical magazines of late, it must be remembered that these are seldom found in the hands of laymen—and not as often as should be in the hands of city officials and health officers. It would seem well, therefore, if the word purification could be superseded by some word more nearly expressing the thought intended.

Sewer Maintenance Essential

Before closing, I want to take up another phase of sewage disposal, that of maintenance and supervision. Every sewer system requires some attention, and a sewage disposal plant a good deal of intelligent attention, if results are to be expected from the standpoint of public health or any other. What can we expect when the care and operation of a sewage disposal plant is turned over exclusively to an official, whose major duties require him to catch stray dogs, empty the cuspidors at the city hall and see that the saloons are closed at 12 o'clock—which is the case in many of our smaller communities.

I once complained to an official in regard to a neglected disposal plant, and he stated that as soon as the potatoes were all dug he expected to be in a position to give the matter some attention.

If, as has been often suggested, the attendant at such plants were instructed in regard to making some simple tests, and these results were reported regularly to state officials, preferably, and certain standards were demanded by these officials, who should also visit such places periodically for the purpose of giving instructions, as well as inspecting the operation, we would have reason to expect results. For this reason, I believe that state supervision of sewage disposal plants is equally as important as highway construction. An engineer would then be in a position to design and lay out his work with the assurance that it would be properly cared for and operated.

Watertight Joints for Pipe Sewers

By Philip F. Miller, B. S.

The problem of making sewers watertight has been a vital one ever since the "separate system" of handling sewage came into use. In former days, when the "combined system" was considered good practice, little attention was paid to joints, as the sewers then were little more than underdrains carrying both sewage and storm water, and, in fact, in many cases it was thought advisable to have open joints so that the sewage would be diluted as much as possible with ground water.

Nowadays, however, with treatment works as the accepted means of sewage disposal, it is essential that the sanitary sewers be laid as watertight as possible, as it is obvious that every gallon of infiltration means extra expense in treatment and pumping. Where cities are so located topographically that the natural slope is in two or more directions, it is considered cheaper usually, to pump the sewage to a common site for settling, filtration or both, so the pumping of sewage is more common than heretofore and the demand for tight joints more exacting.

It is also doubtless true that a considerable saving could be effected in the size

of pipes, as often in calculating sizes of lines, a certain percentage of the flow is allowed for infiltration.

Causes of Leaks

Where cement joints are used, as is the case today in the great majority of sewer work, the causes for leaks are many. They may be roughly divided into two classes:

Leaks due to poorly made joints.

Leaks due to disturbance of completed joints.

Under the first head comes the country-wide complaint of engineers that the average pipe layer will not see that the space at the bottom of the pipe is properly filled with cement. This, perhaps, is the greatest cause of leaks in sewers today.

In wet work where there is water in the trench, it is nearly impossible to make good joints, no matter how much care is taken, as the cement is more or less washed out of the annular space before it has thoroughly set, unless great care is taken to keep the trench pumped dry for several hours.

Even when cement joints are carefully made the line is often disturbed before the cement has set, thus breaking the bond between cement and pipe and making every joint so disturbed worthless as far as being watertight is concerned. In many cases after a line is well jointed and backfilled, a settlement will occur, either in backfill or foundation, and the line being rigidly jointed will crack, sometimes continuously for a distance of 40 or 50 feet.

Stoppage from External Causes

As roots of trees will grow into joints where there is an opening of 1/100 of an inch or more, it is often the case that sewers laid near shade trees will in a surprisingly short time become entirely stopped up. Rootlets once into a joint grow rapidly, and cases have been known where masses of roots over 60 feet long have been removed from sewers.

Trouble Caused by Leaks

The amount of infiltration in sewer lines as ordinarily laid may be far more than is realized by many engineers. In one instance the writer had occasion to visit a disposal plant designed for a maximum inflow of 400,000 gals. per day, and serving a town of some 3,000 inhabitants. According to measurements made at the outfall to the plant, there was no less than 1,500,000 gals. per day being discharged. Needless to say the plant was temporarily useless and the system much overtaxed. In this case the sewers were built by a reliable contractor and designed and inspected by a competent engineer, but the trouble was probably due to the fact that in the summer time when the lines were laid, the trenches were dry and the joints were not as carefully made as they might be, and when they were subjected to a static head of several feet of water, due to excessive rains, the lines developed leaks to an alarming degree.

The writer knows of many instances where, before a single house was connected, sewers carried ground water nearly to the capacity of the treatment plants. It can be readily seen that pumping plants in similar systems would waste a great deal of money by pumping unnecessary ground water. Where excessive leaks occur, sewers often have to be dug up and relaid.

Properties of a Good Compound

From the foregoing paragraphs, it can be seen that a good jointing should have the following properties:

(a) It should have as its base a material that is absolutely waterproof.

(b) It should set quickly so that disturbance could not affect a completed joint.

(c) It should be flexible to such a degree that a deflection of the line would not cause a leak or crack the pipe.

(d) It should have sufficient weight and be poured hot enough so that it will readily adhere to wet pipe.

(e) It should have sufficient adhesiveness so that a joint once made will always be water-tight.

(f) It should resist chemically liquids likely to be found in sewage.

Such a material usually has for its base asphalt, or a similar bituminous substance with a filler added that will give weight, strength, stability and adhesiveness.

The Economy of Laying Waterproof Joints

In wet trenches joints made with a waterproof compound, in many instances, are cheaper to lay than cement joints, altho the cost of the material may be greater. This is a fact, because a line jointed with cement must be kept dry for several hours to allow the cement to get its initial set undisturbed, and backfilling should not be started until several hours after that. This means considerable trench pumping and an unnecessary lapse of time before backfilling may be commenced.

Where compound joints are used the water need only be pumped down momentarily while the joints are being poured, and backfilling may be commenced at once. The saving thus lies in the fact that a joint made with a waterproof compound is at once permanent and watertight and needs no care or labor to prevent damage.

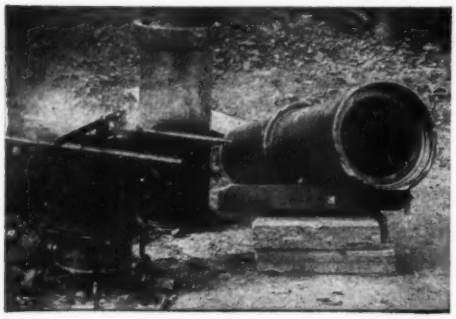
Many contractors prefer to lay joints that they know will be water-tight, even

if the first cost is greater, than to make cement joints that may have to be dug up and repaired.

Method of Making Waterproof Compound Joints

Waterproof compound joints are made in much the same manner that lead joints are made in water mains, except that no caulking of the material is necessary. The jute is caulked into the pipe in the usual way, serving the double purpose of forming a backing to pour the material against and of centering the spigot in the bell. An ordinary asbestos pipe-jointer may be used or, if one is not at hand, short lengths of ordinary garden hose make admirable "runners." In either case the runner should be greased or smeared with wet clay to prevent the hot material from sticking to it. The jointing material is heated in a suitable kettle to a temperature of from 350 to 450 deg. F., or until it runs freely, and as a general rule, should be hotter for the larger sizes of pipe, as the chilling effect is greater.

An ordinary iron kettle over a wood fire may be used, tho a portable oil-heated kettle is handier. The material should be well stirred while heating, and the kettle should be as near as possible to the point



HEATING *filler for joints.*

where the joints are to be poured so that unnecessary cooling does not take place before the joint is run. A handy method for pouring is to use a dipper that will hold a little more than enough for one joint. It takes from 5 to 15 minutes for a joint to cool, depending entirely on the temperature of the atmosphere, and for rapid work it is advisable to use several runners and make several joints at the same time. In making joints on 8, 10 and 12-inch pipe, much time is saved by pouring alternate joints on the bank by standing two pipes upright, calking the jute and pouring the hot material into the remaining annular space. This obviates the use of a runner and then the double length is lowered into the trench and jointed in the usual way.

The economy of waterproof joints depends largely on the pipe layer, as a careless laborer can spill and waste much material.

POURING JOINT *on bank of trench.*

A depth of material of 1½ inches is sufficient to make a water-tight joint and the use of a greater depth than this is unnecessary.

Tests

To get an idea of the adhesiveness and stability of a joint compound, a pressure test was made as follows:

Four short lengths of c. i. water pipe were jointed with the material and the ends sealed in a similar manner. Pressure was applied by a hydrostatic pump and run up to 400 lbs. per sq. in. without the sign of a leak. On increasing the pressure to 450 lbs. the plugs began to push out and the sections to pull apart, but no visible leakage was noted for some time. This test led to the question of making water pipe joints with this compound on account of the enormous saving over the cost of lead, but it was found that difficulty was encountered on account of the small annular space in c. i. pipe not admitting sufficient material to overcome the chilling effect of the iron, and good joints were hard to make.

Pressure tests on tile pipe joints made in a similar manner gave good results as

in nearly every case the pipe broke before a leak was detected.

Some tests on spiral riveted steel pipe, such as is used by the U. S. R. S., were

POURING JOINT *in trench.*

made by dipping one end of the pipe in the hot material and forcing it into the end of the other pipe. The lap was only about 3 inches, but the joint stood 300 lbs. per sq. in. without the sign of a leak.

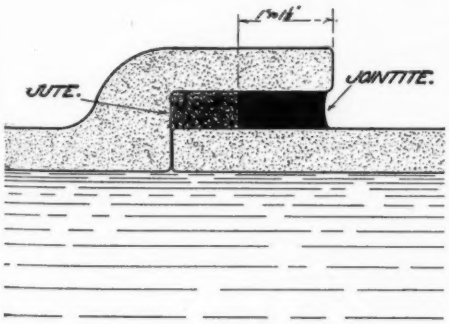


DIAGRAM *of water-proof pipe joint.*

It is extremely difficult to get an idea of the life of a compound, as there are no tests possible that can simulate actual conditions.

The compound used by the writer is entirely inert to the ordinary acids and its waterproof properties should prevent deterioration.

The use of waterproof compounds has been small so far, as compared with cement, but the interest awakened by the idea among engineers and contractors is encouraging, and the use of these compounds is expected to increase greatly this year. Some means of keeping sanitary sewers watertight is imperative and at present the problem seems to be solved in the manner described.

The material referred to particularly in the foregoing article is known as "Jointite" and has been in successful use for about two years.

Concrete Example of Value of Waterways

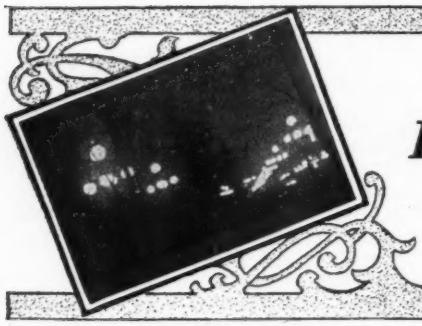
A practical trial of canal transportation was made last year under the direction of Norman D. Fraser, president of the Chicago Portland Cement Company, which he reports as follows:

In August and again in September of last year the Chicago Portland Cement Company undertook to test the utility of the Illinois and Michigan canal. A steamboat and a barge, which were built about thirty years ago, were put in commission and we proved beyond question that the channel is still navigable. Both journeys from LaSalle to Chicago were made in practically four days.

These experiments showed no saving whatever over the all-rail rate, but this was anticipated in view of the small cargoes, 186 and 200 tons, and the antiquated craft at our disposal.

If, however, the Illinois and Michigan canal was dredged and cleaned out to insure a uniform depth of seven feet and the locks increased to 170x35 feet, it would then be possible to operate modern craft capable of transporting in one shipment about 2,000 tons and of making the journey in from two to two and one-half days, which, in point of carrying capacity and time consumed, is, if anything, better than present-day railroad service.

The fleet necessary to transport a cargo of this size, would consist of one steel power boat and five modern steel barges, each 140 feet long, 17-foot beam and 6-foot draught. Their construction and equipment with modern loading and unloading devices, could be undertaken for less than $100,000, $15,000 for each of the five barges and $18,000 for the power boat, but with a steady volume of traffic and good terminal facilities, the saving in the cost of transportation, conservatively estimated at five mills per ton-mile, would, I believe, warrant such an expenditure.



FIRE AND WATER

A System of Waterworks Accounts

By G. S. Olive, Indianapolis, Ind.

This article is by an expert in water works accounting and is part of a paper prepared for the Indiana organization of water works men. It states so briefly and clearly the essentials of convenient and accurate accounting as applied directly to water works plants that it is quite complete in itself and will be of interest to every reader who has to do with the accounting for a public service utility, whether under public or private ownership.

The four principal books of account for any water works should be the general ledger, the general journal, the general cash book and the accounts payable or vouchers payable journal. The last two books are subsidiary to the first, and the general journal is the book of original entry for all items not handled originally thru the general cash book or the accounts payable book. Whatever customers' accounts are kept are also subsidiary to the general ledger. The general ledger is the controlling book. In it appear the accounts showing fixed assets and liabilities, and a summary of the current assets and of the various revenue and expense accounts, the elements of profit or loss, which added to the net investment in the plant, give the proprietary interest. The general ledger should not be a book for details. It should be kept so that at the end of the month, quarter or other period, the vitally important balance sheet, the statement of assets, liabilities, net investment and earnings can be taken from it with the least trouble and in the shortest time. The details of revenue and expense which go to make up the earnings statement can be worked out later; such details call for an analysis of the summarized figures placed on the general ledger and there is no need of holding up the results of operation until it is possible to explain why and wherefore leading to this result. The writer has personal knowledge of utilities which can present balance sheet and earnings statement for any month by the fourth day of the following month, and others where it is an absolute impossibility to get these statements until after the twentieth of the month, the difference being due entirely to the fact that in the second case the general ledger is littered with detailed accounts. It seems at times as tho managers or accountants think they are beating up a dust of secrecy or impenetrability by such methods, but they are really fooling no one but themselves.

Good accounting should contemplate arranging the records in such a way that they will yield the desired information in the shortest time and with the least trouble.

The accounts in the balance sheet given are the essential accounts to be kept in the general ledger. These essential accounts may be analyzed and kept in just as much detail as circumstances warrant. Thus the accounts kept in more detail might be as follows:

ASSETS.

Fixed assets and funds.
- *Tangible assets.*
  - Collection system (reservoirs, cribs, canals or wells).
  - Purification system
  - Pumping system
  - Distribution system
  - Miscellaneous properties
- *Intangible Assets.*
  - Franchises
  - Going value
- *Funds.*
  - Sinking funds
  - Depreciation funds

Current and Nominal Assets.
- Cash
- Investments
- Accounts receivable
- Prepaid accounts
- Materials and supplies

LIABILITIES AND PROPRIETARY INTERESTS

Liabilities.
- Funded debt

Customers deposits
Notes payable
Accounts payable
Accrued interest
Accrued tax
Reserve for unearned income

Proprietary Interests.
Capital stock
Reserves
Depreciation
Amortization
Bad debts
Surplus and undivided profits

In addition to these balance sheet accounts, the only ones to be kept are the revenue and expense accounts, which show the earnings of the plant and which are closed off at the end of any period through the profit and loss account, into the balance sheet account, "surplus and undivided profit."

These accounts are as follows:

Water service revenue
Rates for metered water
Rates for unmetered water
Rates for municipal service
Miscellaneous water revenue

Miscellaneous revenue.
Rents
Interest and discounts
Profits from merchandise and sundry sales

General expense
Administrative and commercial expense

Operating Expense. (Operation, maintenance and depreciation.)
Collection system
Purification system
Pumping system
Distribution system

The amount remaining after deducting from the total revenue the general expense and operating expense is the net operating revenue. From this net operating revenue, the fixed charges must be deducted. The fixed charges are taxes and interest on funded debt, to which should be added in individual cases such items as sinking fund or amortization revenue charges. The amount remaining after the deduction of the fixed charges is net earnings or deficit and goes as a credit or charge as the case may be to surplus and undivided profit. The accounts given above are meant to be only typical accounts. They can not, of course, cover the needs of every individual plant. The revenue and expense accounts should cover every current asset and liability; otherwise, the net profit or deficit does not show what it is expected to show, the actual result of the operation of the plant.

The fixed charges are ordinarily handled thru the general journal direct to the general ledger accounts. The interest on funded debt account and the tax account should be charged and the accrued interest and accrued tax account credited monthly with that period's proportion of the annual amount due. The practice with reference to revenue is comparatively uniform. The detailed accounts are kept in the customers' ledgers and only the totals of the monthly charges and credits posted monthly to customers' controlling accounts in the general ledger. The credits are made thru the general cash book, charging the cash account, and the charges, thru the general journal, crediting the revenue accounts.

Expense and Liability Accounts

The keeping of the expense side of the accounts is the best field for missionary work in the entire realm of water-works accounts. Most managers will agree, I believe, that the revenue will ordinarily take care of itself. A water-works plant which does not show a gradual upward trend to its revenue curve is, to say the least, unusual. The expense, on the other hand, needs the most careful watching. Not only the details of the expense need watching, but those details need to be gathered together in such a form that the total expense of the entire plant as well as of its component parts, can be observed by the manager. It has been the tendency in the past to watch the details without paying much attention to the tendency of the entire costs; the superintendents have taken so much time to watch individual invoices for materials purchased that they have lost sight of the aggregate amount. It should be a first principle in all water-works accounting that no cost information should be made up unless it be from an analysis of the general book figures. Accounts or statements made up from any other source are absolutely unreliable.

All liabilities incurred by the plant for general or operating expense should go to the general ledger thru the vouchers payable journal. The pay-rolls or invoices for material purchased, after being O. K.'d by the authorized official, with information on each invoice sufficient to indicate for what use the material was purchased, should be entered on and attached to a voucher payable which includes all the invoices for any month from any one concern and which shows the accounts to which the items are chargeable. These accounts are either expense, betterment or renewal accounts, the betterments being charged to fixed assets and renewals to the reserve for depreciation. The vouchers are entered in the voucher payable journal, the total amount to the credit of vouchers payable in the first column and the amount charged to expense accounts in the appropriate departmental column across the page. Only the monthly

totals are posted from the voucher journal to the general ledger. The same is true of the items from the general cash book and from the general journal. Only monthly totals are posted to the general ledger. Any analyzed information desired concerning the expenses may be obtained from a detailed expense ledger, auxiliary to the voucher payable journal. This method of having the general ledger handle only monthly totals and summaries makes it possible to arrive quickly at the final reults at any closing period.

Fire Plugs Broken by Automobiles

An accident of such frequent occurence in the city streets as to call for some effective protective device is the breaking of fire hydrants by automobiles. The photograph shows the result of such an accident in a Los Angeles street, caused by the impact of a heavy truck against a

GEYSER *on Los Angeles street corner; fire plug broken by an automobile truck.*

cast iron fire plug. The result of such accidents is the tying up of traffic, sometimes for hours, until the water can be turned off and the hydrant replaced, for the "geysers" throw water into the air to a height of 30 or 40 feet and flood the thorofare. Still more serious is the result when such an accident occurs at the same time as a fire in the vicinity. With a needed hydrant out of commission and a great lowering of the water pressure this is a serious menace. It is a question whether it would be advisable to change the location of hydrants, placing them back from the curb, or to protect them by stout metal posts set in such a position as to receive the blow of the vehicle and protect the fire plug, or set the hydrant beneath the sidewalk and cover it by a heavy metal plate like a manhole cover.

The following report from San Francisco is interesting in this connection:

"The Exposition hydrants are to be a different type from that used by the city and are to be set in the middle of the street in manholes. They will be below the street surface and access to them will be had by raising the manhole covers. This type of hydrant offers no obstruction in the streets and walks when not in use. There will also be connections thru which the fireboats can pump into the system."

Value of Water Meter Demonstrated

On February 14 Mayor Carter H. Harrison vetoed an order of the city council to the commissioner of public works to remove a water meter from the premises at South Center avenue and West Sixty-third street, presenting as his reason the following from Jos. O. Kostner, deputy commissioner:

"The property consists of a fruit store and flats occupying a building 30x71 feet, two stories high. The meter was installed January 21, 1911. The table given below shows the monthly bills since that date:

January 21, 1911.	Gross.	Net.
February 3, 1911.....	$20.63	$17.33
(Inspection showed leak in basement.)		
March 23, 1911.....	10.00	8.40
April 21, 1911.....	2.50	2.10
May 24, 1911.....	3.13	2.63
June 28, 1911.....	2.50	2.10
July 24, 1911.....	2.50	2.10
August 23, 1911.....	4.38	3.68
September 21, 1911.....	3.13	2.63
December 19, 1911.....	7.50	6.30
January 19, 1912.....	7.50	6.30
February 21, 1912.....	10.00	8.40
(Inspection showed leaking and wasting.)		
March 23, 1912.....	8.13	6.83
April 23, 1912.....	3.75	3.15
May 21, 1912.....	4.38	3.68
June 22, 1912.....	5.00	4.20
July 24, 1912.....	3.75	3.15
August 21, 1912.....	3.75	3.15
September 24, 1912.....	6.88	5.78
October 22, 1912.....	6.25	5.25
November 19, 1912.....	5.63	4.73
December 19, 1912.....	11.88	9.98
January 23, 1913.....	30.63	25.63
(Inspection showed leaking and wastage.)		
Two years		$137.50

"It will be noted that the revenue to the city from this building in two years was $137.50. The frontage assessment for this building would be at the rate of $34.50 gross, or $29.33 net per annum.

"This is a splendid example of the benefit which the city derives from me-

ters. The owner of this property could reduce his bill to a very reasonable sum by taking care of the plumbing. If he does not choose to do so, it is fair that he should pay for the extra water wasted through his plumbing."

Thawing Water Pipes by Electricity in Evanston

By C. C. Saner, Deputy Commissioner Public Works, Evanston, Illinois.

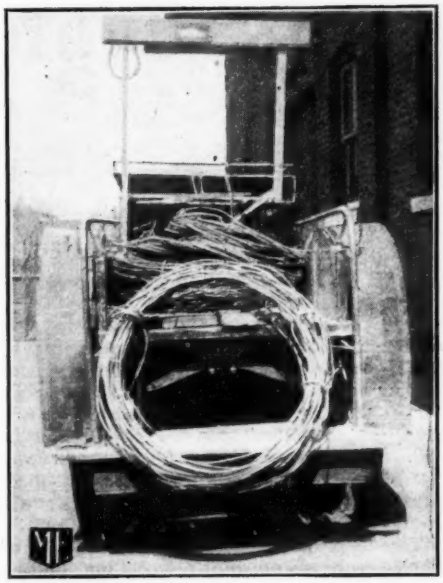
The city of Evanston has owned its water works since their construction almost forty years ago. As the first two months of 1912 were unusually cold and many service pipes were frozen, the city helped relieve the conditions by equipping wagons to thaw out these pipes by electricity. Evanston is in a latitude of 42 deg. 2 min. The soil varies from clay to sand and gravel. The frost penetrated as deep as 5 ft. 2 in. during the winter, and there was fear of the mains freezing.

An examination of the weather records maintained by the department shows that December, 1911, was not unusually cold, the mean minimum temperature being 25 deg. Some snow fell in December, but was melted by rain on the 21st and the 31st. Starting on January 5th, the minimum temperature was as follows: —11, —13, —17, —7, —4, —8, —8, —13, the mean minimum for the month being 0; the mean minimum for February was +14, and for March, +20. The first frozen service to be reported was on January 10, and as several were reported at the same time, the city equipped a wagon with transformers and wire to thaw out these services. The demand was so heavy that another wagon was soon equipped and put into operation. The table shows a record of work done by the second wagon. Numbers 29 and 30 were the first services thawed, and as the crew was somewhat timid about applying the current, three hours were spent using 55 volts and 130 amperes, with no results. When this amount was increased to 110 volts and 280 amperes, the service was thawed in twelve minutes. The largest service thawed was a 4-inch cast iron.

A study of the table will show that the length of lead from the transformer to the service does not bear any ratio to the time taken to thaw the service—110 volts with 300 to 400 amperes thawed most services in from one to ten minutes.

The crew consisted of a foreman, two electricians to make the connection from the primary wires to the transformer and at the service, and two mechanics to disconnect the gas and water pipes, the gas being disconnected to stop any danger of short circuiting and heating gas pipes.

In thawing pipes, the wagon stopped at the nearest pole on a primary line, where connection was made with the electric current. One lead of wire was connected to the nearest fire hydrant and the other lead to the service. Where two services



EQUIPMENT WAGON *for thawing water pipes.*

were frozen in nearby houses, the second house was used instead of the fire hydrant, thawing out two services at once. The crews on this work thawed out eight services a day.

	Volts.	Amp.	Time of current in use.	No. ft. lead from transformation to serv. con.
1	110	336	3 min.	300
2	110	336	7 min.	415
3	110	336	.....	...
4	110	225	40 min.	420
5	110	600-590	35 min.	210
6	110	400	10 min.	250
7	110	430	40 min.	150
8	110	480	20 min.	300
9	110	320	5 min.	250
10	110	430	2 min.	225
11	110	400	3 min.	250
12	110	400	3 min.	350
13	110	384	4 min.	150
14	110	224-35 min. 304-remdr.	40 min.	150 ...
15	110	320	9 min.	200
16	110	336	6 min.	300
17	110	432	10 min.	300
18	110	354	14 min.	300
19	110	272	15 min.	200
20	110	416	1 min.	250
21	110	320	8 min.	150
22	110	378	17 min.	60
23	110	288	3 min.	350
24	110	368	4 min.	150
25	110	268	6 min.	400
26	110	320	4 min.	100
27	110	450	2 min.	75
28	110	380	4 min.	150
29	...	...	3 hrs.	420
30	...	...	12 min.	...
31	110	...	30 min.	...

32	110	320	6 min.	450
33	110	560	5 min.	150
34	55	280	7 min.	...
35	110	260	28 min.	...
36	110	328	6 min.	...
37	110	268	7 min.	...
38	110	360	17 min.	...
39	110	180	45 min.	...
40	110	260	23 min.	...
41	110	...	6 min.	...
42	110	...	4 min.	...
43	110	...	2 min.	...
44	110	...	34 min.	...
45	110	...	4 min.	...
46	110	432	2 min.	...
47	110	368	7 min.	250
48	110	352	2 min.	300
49	110	268	3½ min.	450

Standards of Purity of Water Supplies.

Efforts were begun in 1894 in the American Public Health Association to establish standards for the analysis of water, including in particular its sanitary analysis. A report on standard methods of water analysis was made in 1905, and a revised set of methods was issued by another committee in 1910, so that the standards are modified as advances in science demand.

The next question is as to standards of purity for water supplies. This is discussed by Joseph W. Ellms, consulting engineer, in a paper before the Indiana Sanitary and Water Supply Association, in which he treats also of methods of controlling the application of these standards and bringing public water supplies into conformity with them.

He states that quite apart from bacteriological methods of examination, we know by observation that settlement, filtration or disinfection of public water supplies leads to a reduction in certain diseases which appear to be derived from drinking polluted water. Indirectly, therefore, it becomes possible to establish a relation between the bacterial content of such waters before and after any method of purification. A polluted water which has had 99 per cent of the bacterial life removed from it can be reasonably agreed upon as safe under most conditions. But whether that water shall not contain more than 100 bacteria per cubic centimeter after purification, or whether it shall not have more than 5 per cent. of one cubic centimeter samples giving evidence of the presence of the bacillus coli, to be considered hygienically safe, is a matter upon which doctors are likely to disagree.

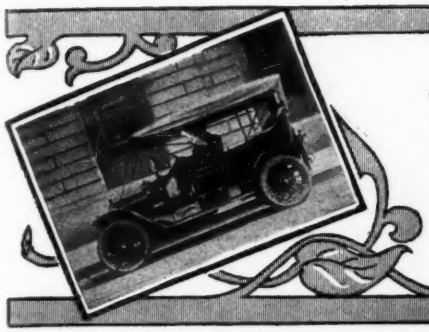
Standards of purity for public water supplies will have little value unless some central authority has power to enforce them upon backward and reluctant communities. Some of our states have vested considerable authority in matters pertaining to water supplies and sewage disposal in the state boards of health, Where such authority is properly exercised and subject to review by legally appointed scientific experts, the best of results may be obtained, i. e., an ignorant or parsimonious community could be protected against its own disregard of sanitary laws. There is a broad field for the exercise of the national government's authority in matters relating to the pollution of interstate and international waters, which may be used as sources of public water supply. If the now scattered bureaus of the national government which pertain to public health were consolidated in a National Department of Health much might be done toward establishing standards of purity for public water supplies, even though the national government was unable to supervise supplies exclusively within the jurisdiction of the several states.

Some of the points which such a body should discuss are as follows:

1. What diseases may be legitimately regarded as water borne? This involves a consideration of the Mills-Reincke phenomenon and the Hazen theorem as set forth by Prof. W. T. Sedgwick and J. S. MacNutt, and the ideas of chronic intestinal tract infection advanced by N. S. Hill, Jr., and L. R. Whitcomb. It means a careful analysis of all the available and reliable vital statistics of those communities having impure water supplies as well as those having pure supplies.

2. A clear definition of what really constitutes a pure drinking water. This means that much light is needed upon the relative numbers and kinds of bacteria, and of the nature and amount of the organic and inorganic matter which may be present in public water supplies, and their significance in the causation of disease. It necessitates the examination of the available bacteriological and chemical data of public water supplies, and their classification in relation to vital statistics.

3. The selection of the maximum limits for the numbers and kinds of bacteria in a drinking water, and the permissible amounts of organic and inorganic matter which such a water may contain. This selection, of course, will be the result of the logical conclusions reached from a study of the compiled statistics, and should be made only after a careful consideration and free discussion of the evidence.



Automobiles in Municipal Service

The Automobile in the Police Department

By William W. Rhoades, Superintendent of Police, Peoria, Illinois

The police department was the first department of the city of Peoria to transform its equipment from the horse-drawn vehicle to that of the gasoline machine.

With the substitution of the old police patrol, which for many years hauled the city's wrongdoers to the calaboose behind two horses, by a great auto patrol, and the like change in the ambulance service, the police department was completely renovated. The change has by no means been so great as that which will be necessary to rejuvenate the fire department, but it has been none the less important.

WILLIAM W. RHOADES, *Superintendent of Police, Peoria, Ill.*

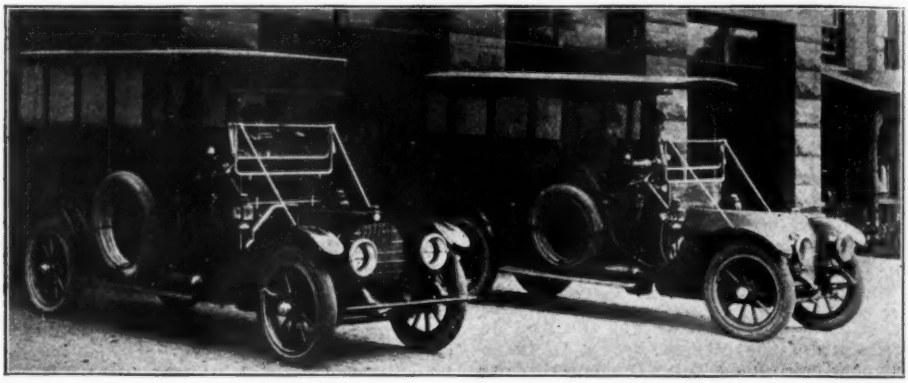
The installation of the Gamewell electric signal system made of the Peoria police department one of the most efficient in the United States. Costing many thousands of dollars, this system enables the officers at the central station to obtain the patrolmen on the beats at a moment's notice by means of the flash lights and the bells. This installation is but one of the few installed in this country, and it brought the Peoria department to a high standard. But it remained for the biggest improvement of all to come within the past year when the new auto patrol and auto ambulance were placed in commission. Both are built along the same lines and with practically the same equipment and cost in the aggregate somewhat over $5,000. The patrol was the first to be put into commission, and so great was its success that the appropriation necessary for the purchase of the ambulance was soon obtained. The two are practically the same in both power and outline, the only difference being that the ambulance is fitted especially for the accommodation of stretchers for the sick and wounded, while the patrol is arranged with benches for the disturbers of the city's peace. Either can be used in an emergency to assist the other, should the demands become too much for the one machine to handle.

The improvement of the new automobile over the old style of horse-drawn vehicles cannot be overestimated. So great has been the increase in the efficiency of the department with the automobiles in commission that the slight increase in cost is far counteracted. The combination of the Gamewell system, designed to make more speedy the workings of the department, with the new autos, makes the department one of the most efficient branches of the city's service.

The police patrol, in particular, is called upon to make quick trips to the remotest parts of the city. The need of promptness in this department is no less pressing than in the fire service, and while in the latter there are wagons stationed in every part of the city, the police branch has but one central station many miles from some of the beats which the patrolmen cover. Formerly a run to the remote police box at the corner of Washington and Western avenue in the extreme south end of the city, an important station, and

one which required the service of the patrol many times each week, occupied nearly, and sometimes more than an hour. Now the round trip can be made in less than fifteen minutes.

Under the old system, should the patrol be out on one of these long trips, and another call came in, it was necessary to call on the ambulance, and should a third call then come in, the police department was helpless. Under the new system such an event is practically impossible. There has not been a time since the two were in commission that both were outside the patrol house on Madison street for a period as long as five minutes. This one consideration alone would be enough to justify their use.



MOTOR PATROL AND AMBULANCE, *Department of Police, Peoria, Ill.*

But it is in disasters like the Wollner Distillery accident of last spring, when 20 Bradley Institute students were injured by the falling in of a floor, that the full force of this argument is felt. At that time the auto-ambulance had not yet gone into service, and it was the patrol which did the major portion of the work. When the call for help came in, both machines were sent out. And as the patrol was dashing to the distillery for its second load of sufferers, it passed the rapidly-tiring horses on their way to the scene of the accident for the first load.

Our machines were operated and maintained for one year for $226.78 less than horse-drawn vehicles for a similar length of time.

Motorizing Pittsburgh Fire Department

The city of Pittsburgh, Pa., has not yet made much progress in motorizing its fire department, altho the steep hills so general in its topography would seem to demand it. Up to the first of the year 9 combination chemical and hose wagons and one tractor to attach to an engine in service had been purchased. Three new tractors will be delivered soon.

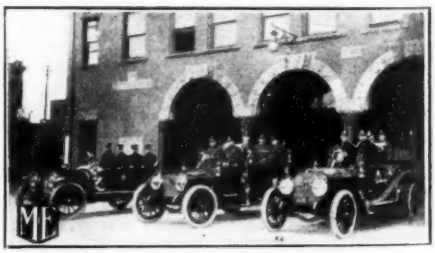
A bond issue of $240,000 for motor apparatus was voted in November, 1912, and the council has authorized the expenditure of $120,000 of this in 1913. Bids are now asked for 15 combination chemical and hose wagons, 4 motor tractors and 3 steam fire engines with motor traction.

The Motor vs. The Horse

By W. P. Weeks, Chief of Fire Department, City of Battle Creek, Michigan

With the advent of motor-driven fire apparatus, we have cut our total fire loss four-fifths in two years.

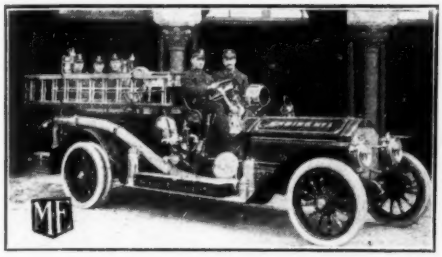
The average up-keep for motors is but 14 cents per day, while the up-keep cost on horse-drawn apparatus runs to $1.20 per day.



MOTOR APPARATUS, *Battle Creek, Mich.*

We recently recommended the purchase of a motor truck, costing $5,500 and driven by a motor the size of the one now in our pumping engine. This will replace the three-horse aerial truck that now costs $1.80 per day to maintain, as it is necessary to have three horses to pull it. In

addition to this, the truck trails the motor apparatus, arriving several minutes later than the automobile. Few people realize the importance of having a fast truck to work with the fire department. It is the fireman's tool box. The heavy tools that cannot be loaded on the other

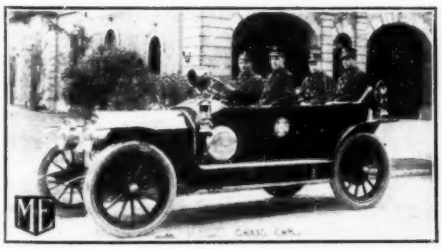


SIX-CYLINDER *chemical engine and hose car.*

apparatus are carried here. In addition to this, there are all of the life-saving devices, such as nets, ladders, ropes, and similar apparatus. This should be on the ground as soon as the firemen are, if it is to be of any use in saving lives.

Our truck is driven by a 6-cylinder engine, and carries a 40-gallon chemical tank, all the life-saving equipment, including nets and ropes, pompier ladders, an arrangement for climbing from story to story of a tall building, a 50-foot ladder, two 35-foot ladders, and one each of 30, 25 and 20 feet. There are also two 14-foot ladders for roof work. All of these are of special reinforced construction and very light.

One of our recent improvements was the addition of a $9,000 triple pumping en-

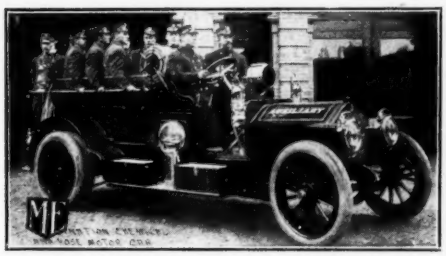


CHIEF'S CAR, *Battle Creek, Mich.*

gine, which is a whole fire department in itself, taking the place of five horses, and furnishing as much apparatus as is kept at No. 2 station. This one car carries a pumping engine, pumping 700 gallons of water a minute; a chemical engine, a hose motor car, with ladders, hooks, and other tools for fighting fire. In the six months it has been in use, it has cost the city $75.00 for maintenance.

A 3-horse truck costs the city $663 a year for maintenance. During the past year the city has paid out $2,652 for the up-keep of its 12 horses, which exceeds by far the cost of the motor apparatus, and added to this is the fact that the motor apparatus gets to the fire quicker than the other.

Our department now owns the following motor apparatus: One 50-h. p., 4-cylinder



75-H.P. *chemical and hose squad car.*

automobile, 1 75-h. p., 4-cylinder combination chemical engine and hose squad car, 1 6-cylinder triple combination pumping engine (700 gallons capacity), chemical engine and hose wagon; 1 105-h. p., 6-cylinder combination chemical engine and city service hook and ladder truck.

Modernizing the Hartford, Conn., Fire Department

By David A. Nicholls, Hartford, Conn.

Seven years ago the city of Hartford, Conn., had a fire department as good as the average fire department of a New England city of its size. It had permanent men, some good apparatus, and had had good success in handling fires. Yet the city was growing faster than the partment could afford to grow, and the serious problem of the expansion of the department faced the city officials.

In one of the fire stations was an especially antiquated old piece of apparatus, an old one-horse hose reel, an eyesore and a menace to the men who had to ride on it. This piece of apparatus opened the way for a modern fire department. The station was even more antiquated than the old reel and was not large enough to hold a modern hose wagon and another horse with what was already there. The house was too old to enlarge and the city could not build a new fire station.

The automobile was the solution of the problem, as it would take no more room than the old reel and cut out one horse.

The wagon had to be eventually rebuilt,

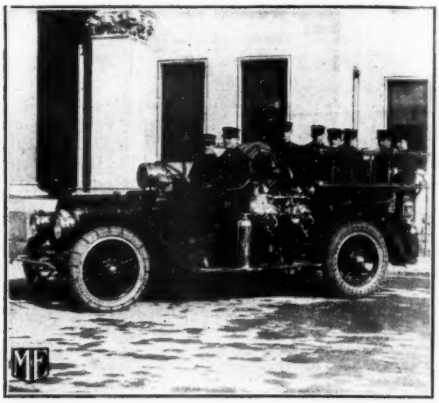
a four-cylinder engine replacing the two-cylinder that it was originally equipped with. Then it was found that the automobile could get to the fire faster, cost less to maintain when not in actual service, and was more efficient.

Then the chiefs gave up their buggies for cars. In 1910, another automobile added proof that horses are no longer of use in fire fighting, so that before long the Hartford fire department will be horseless.

A chemical company of five men, located on Pearl street, known as No. 9, answering only a few alarms in the heart of the city, was replaced by a flying squadron of 8 men in a Pope-Hartford automobile, equipped with two 40-gallon chemical tanks, to answer all alarms. Without the cumbersome load of 2½-inch hose, it has many times reached the fire, several miles away, before the nearest horse-drawn company, sometimes only two or three blocks away. This company, known as Squad A, has paid for itself many times over. In over three years it has been responding to all bell alarms, as well as attending to many still alarms in the center of the city, and has not had one serious accident.

Last August the Pope-Hartford Company supplied three more hose wagons, new models, an improvement over the first one. They are chain driven, are larger, and, besides carrying a 40-gallon chemical tank and 300 feet of one-inch chemical hose, each carries 1,000 feet of 2½-inch hose, with the other usual paraphernalia. They are located one to reach western points of the city quickly, another southern points, and another northern points. In each case the company is quickly reinforced by Squad A, and by the time the horse-drawn companies get there they are seldom needed. This has saved building several new stations this year, which, without automobiles, would have been imperative because of the rapid growth of the city. A new tractor-drawn engine was added last fall, doing away with three more horses, and giving far quicker service to parts of the city where several bad fires have occurred for the want of an engine in the early stages of the blaze.

HOSE WAGON, *Hartford, Conn.*



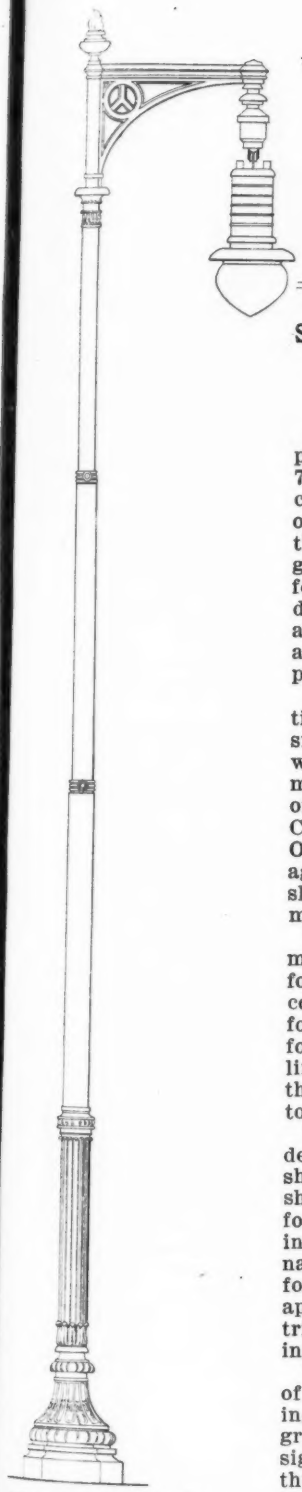
FLYING SQUADRON, *Hartford, Conn.*

Chief Augustus Loomis has recently completed a tour of a number of cities where motor apparatus is extensively used, and his report is overwhelmingly in favor of an entirely motorized department. If this is done, it will mean a saving of nearly $11,000 a year on the fodder bill alone, to say nothing of the saving of replacing floors frequently where horses have worn them out. It will take two drivers in nearly every one of the fourteen companies affected and make them available for fire duty after they have motored to the fire, a clear gain of 28 working men for fire duty.

It will cost Hartford approximately $100,000 to motorize and, at the next city election, the voters will be asked to approve a bond issue for that purpose.

Hartford is really a pioneer in self-propelled apparatus. The first steam propeller was put in commission in this city in 1878. At present there are two heavy steam propellers, but these will probably give way to the tractor, as the sparks flying from the stack often set fires along the route. Besides, they are cumbersome and not as speedy as the tractor, and are a constant expense, in service or out of it, as a heavy pressure of steam must be kept up every minute, ready to start out under power when the gong calls. The saving in coal here is second only to the expense of feeding a lot of horses that are working only a small fraction of the time in the outlying sections.

The accompanying pictures show the two types of cars now in service. One, the lighter car of the flying squadron, and the other the hose wagon that is worth half a dozen horse-drawn hose wagons.



ORNAMENTAL ARC LAMP STANDARD

STREET LIGHTING

Standard Lamp Post Adopted in Chicago, Illinois

By J. C. Schniedwind, Chicago.

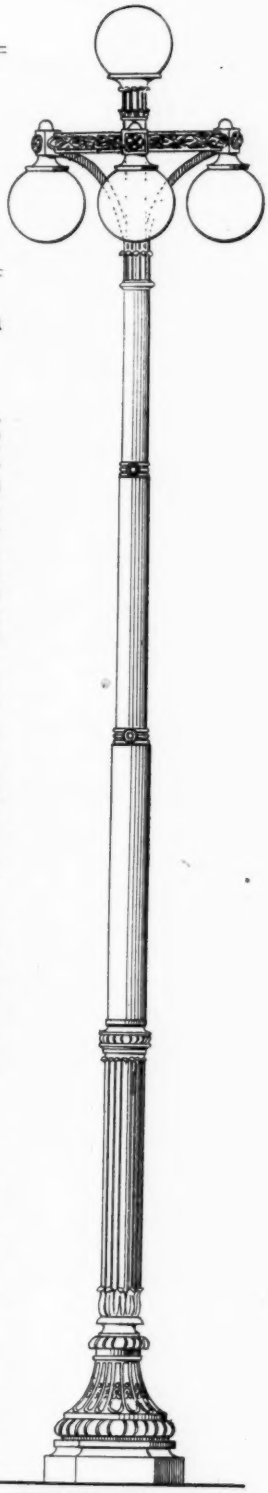
On July 17, 1911, a committee was appointed by Mayor Harrison composed of 7 aldermen, 3 representatives of the Chicago Plan Commission, 3 representatives of the Chicago Association of Commerce, the City Electrician and the electrical engineer of the sanitary district of Chicago, for the purpose of establishing a uniform design for posts, globes, etc., for electric arc lights for streets, and reporting upon an ordinance, providing for standard posts for electric street lighting.

After having given much thought and time to the subject, and after having considered all designs, models, ideas, etc., which were presented to them, this committee drew up a report and a proposed ordinance, which was presented to the City Council, which ordered it published. On January 27, 1913, this ordinance was again submitted to the City Council, slightly amended, and passed unanimously.

To provide for uniformity and yet permit of variation, the ordinance provides for three types of posts, namely, posts for commercial incandescent lighting, posts for outlying district arc lighting and posts for downtown district arc lighting; the limits of these districts to be defined by the City Electrician, who is empowered to change same at his discretion.

The ordinance provides for a specific design of posts for each classification, as shown by accompanying drawings. No. 1 shows accepted design of standard post for commercial incandescent street lighting, No. 2 shows accepted design for ornamental iron post and bracket approved for arc lights in downtown district. That approved for arc lights in outlying districts differs from the latter only in having no ornamental iron work on the post.

Where posts are used for the purpose of commercial incandescent street lighting, they must be constructed of a good grade of cast iron and conform to the design as shown. The height of the post thruout the city, except in the business



ORNAMENTAL INCANDESCENT LAMP STANDARD

district, shall be such that the center of the lower globes will be 12 feet above the curb adjacent to which it is placed. In the business district the height of 12 feet is changed to 16 feet.

The post for downtown district are lighting is to consist of one malleable iron bracket, one tubular steel mast, two cast iron section collars, one cast iron ornamental collar, one cast iron pole top and one cast iron base, as shown in Fig. 2. The mast is to consist of three sections, respectively, 4 inches, 5 inches and 6 inches in diameter, the brackets to fit snugly, the section collars to be sliding fits on the 4-inch and 5-inch sections of the mast. The ornamental collar adjoining the mast is to be a sliding fit and held snugly in place over the 4-inch section of the mast and the ornamental base to fit snugly over the 6-inch section of the mast. The height of the post is to be such that the arc of the lamp will be 25 feet above the top of the curb, adjacent to which it is placed.

The specifications for the post for outlying district arc lighting, with the exception of ornamentation, are the same as for the downtown district, other than the height of the arc is 22 instead of 25 feet.

The materials of which the post is constructed must pass certain tests enumerated in the ordinance; where castings are uesd they must meet all requirements provided for in specifications governing same, as adopted by the American Society for Testing Materials.

Previous to assembling post, the mast after being thoroly cleaned, must be given a coat of red lead or subjected to a Sherardizing treatment; all castings are to be given a brush coat of red lead and oil.

After having been assembled and erected, a coat of weather proof paint of a color harmonizing with the local surroundings is to be applied to the post. Final choice as to color rests with the city electrician.

The posts for incandescent lighting are to be fitted with five lamps, one at the top of the post with a 12-inch globe and, 2 feet below, four lamps at right angles to each other, each to be fitted with a 9-inch globe, all globes to be of an approved diffusing glass, so constructed as to subdue the light intensity.

All posts are to be set in a rectangular body of concrete from the bottom of the post to within 3 inches of the curb grade, the depth depending upon the nature of the ground, approximate depths being as follows: Sand, 5 feet; clay, 4½ feet, and rock, 2½ feet.

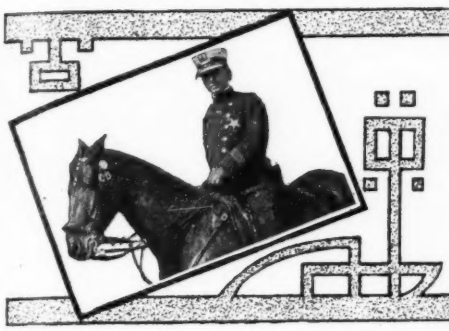
Owing to the large number and varied designs of posts used in commercial incandescent street lighting, which have already been installed at various times thruout the city, provision has been made to exempt them from a violation of the ordinance, providing that within a period of six years these posts are made to conform to the adopted standard governing their location.

As conditions at times will not permit of a full compliance with the provisions of this ordinance, the city electrician is empowered to sanction such changes as he deems advisable.

To facilitate compliance with this ordinance the city electrician, Ray Palmer, will furnish all responsible lamp post manufacturers with detail drawings and specifications governing the construction of the standard lamp post.

Enormous Savings for People of Los Angeles, Calif.

The Board of Public Utilities is engaged in making detailed inventories and appraisals of the properties of all the public service corporations operating in the city of Los Angeles, together with an investigation of their receipts and operating expenses. In addition to the reports which the companies are required to furnish the board, independent statements are made from the books of the companies by the board's accountants, and a continual check is kept on the companies' operations by the engineering and accounting staff. One of the benefits to the people from the regulation has been a substantial reduction in rates, the estimated saving to consumers being more than $500,000 in electric rates, over $250,000 in gas rates, and of over $300,000 due to the increased heating value of gas, brought about by the board's supervision of the gas inspection department, making a total saving of $1,050,000 for gas and electricity for the year 1912.



LEGAL DECISIONS

Effect of Inspection and Acceptance Upon Pavement Guaranty

The Louisville case referred to in the article on "Paving Conditions in Southern Cities" in MUNICIPAL ENGINEERING for February, p. 73, has been decided by the Kentucky Court of Appeals. The case as stated there turns on the claims of the contractor that the specifications were defective and that the approval of the inspector and acceptance of the street by the city relieve him of responsibility under his guaranty. The peculiarities of the case, the assumption by the judge of engineering knowledge and the errors in conclusions which he makes on account of his lack of engineering experience make the opinion of the court of interest enough to warrant publishing it almost in full. The title of the case is City of Louisville v. L. R. Figg Co.

It was agreed in submitting the case that should the court be of opinion that it is the duty of appellees under their guaranty to remedy the admitted defects in the work which they did under contract with the city, they will proceed to do so under the supervision and direction of the Board of Public Works and pay the costs of the action; but that if it should be determined that appellees were not required to remedy the defects in said work, the action should be dismissed at the costs of the city.

In 1910, the contract for the reconstruction of part of Seventh street with vitrified brick was entered into under carefully prepared specifications, including:

"The party of the second part hereby guarantees the work done under this contract, and the materials used in the construction of the same are free from defects or flaws, and this guarantee is for a term of five years from and after the acceptance of the work by the Board of Public Works. It is hereby especially agreed and understood that this guarantee shall not include any repairs made necessary by any cause or causes other than defective work or materials in the construction of the improvement."

All agree that the street is now badly in need of repair and that the bricks, cement and sand used in the work were up to the specifications.

The city claims bad workmanship or imperfect preparation of materials, while the contractor claims that the specifications were at fault. The only direct evidence in the record as to whether these specifications were strictly followed is given by L. R. Figg; and the city engineer, who, of course, was only present for a short time each day while the work was in progress, testifies to no single fact which came under his personal observation, showing that the specifications were not strictly adhered to. Inspectors and assistant engineers were not called as witnesses.

Many expert witnesses were introduced by both sides, some of them learned and experienced as to the construction of vitrified streets, and as might be expected, their evidence, based upon hypothetical questions, is in some respects very conflicting.

Most of the expert testimony of the city was directed at proving that the cement grout or filler which was required to be used after the bricks were laid, was not properly mixed or applied as required by the specifications; that if it had been properly mixed and applied, it would have gone down in between the bricks and cemented them together so as to form, after it was firmly set, a solid monolithic mass, which would have had ample strength to resist any expansion.

The preparation and manner of applying this grout filler were prescribed in minute detail in the specifications, and appellees' evidence shows strict compliance therewith; the city engineer says that it was done in accordance with the specifications while he was present. The city's complaint is that this grout was not prepared or applied so as to fill the cracks between the bricks down deep enough; but that by reason of its im-

perfect preparation or application, in many places, it only went down one-quarter or one-half inch from the top of the bricks, and did not, therefore, after it was set, make a strong or solid monolithic mass, whereas, if it had been properly prepared and applied, it would have gone down in between the bricks to the bottom, or near the bottom, and would in that way, after being being set, have composed a solid and practically indestructible street.

Many of the bricks taken from the street disclosed this, but appellees contend that this was because after the brick were laid on a loose layer of sand two inches thick, they were required to be rolled in such manner, and to such extent and with such weight, as to force the sand up between the cracks in the bricks and for that reason the grout could descend only until it met the sand.

It is altogether reasonable that with the enormous weight required by the specifications rolling over and over the bricks after they were laid on the cushion of loose sand, the pressure would cause the sand to come up between the cracks in the bricks some considerable distance.

The evidence discloses that some time after the completion of the work when vehicles would pass along the street, there would be a rumbling sound, thereby tending to show that the expansion had caused the bricks to buckle or raise from the concrete foundation, and that heavy traffic over it while in that condition would break and shatter the bricks; this was clearly one, if not the chief, cause of the imperfect condition of the street. The evidence is ample that this is a natural result where no provision is made for such expansion and contraction.

The specifications provided for expansion cushions on each side of the street next to the curbs, and prescribed its composition and dimensions; but no provision is made whatever for an expansion cushion lengthwise of the street, and the witness, L. R. Figg, states that on many occasions during the progress of the work, he notified the city engineer and the city officials that there ought to be expansion cushions every fifty or seventy-five feet lengthwise of the whole work, which was 744 feet long.

It is in evidence that the temperature in the city of Louisville varies 120 to 130 degrees at different times of the year, and it is perfectly manifest from a common sense view that these extremes of temperature should in some way be provided for in the construction of such work.

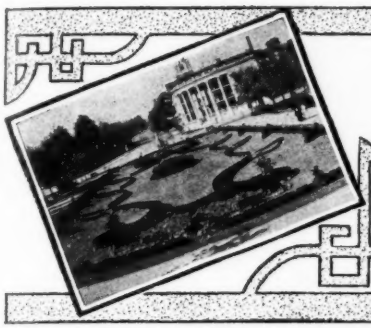
The court concurs in the finding of the chancellor in the lower court that the condition of Seventh street was primarily due to the expansion of the materials with which it was paved, and that under the specifications no other result could have been reasonably expected, and that the city has failed to show that appellees in any way failed to live up to the specifications.

Highway Construction by Federal Government

That National Government participation in the highways progress of the country should first concentrate itself upon main roads was the predominant current of opinion in the Second Federal Aid Good Roads Convention, held in Washington, D. C., during inauguration week. Called by the American Automobile Association, motorist delegates, nevertheless, were in the minority, as general roads bodies and chambers of commerce supplied the greater part of the several hundred representatives from the forty-six States, which, in one form or another, were embraced in the nation-wide gathering.

No more concrete summing up of the situation was expressed than that employed by Charles B. Stetson, Chairman of the Executive Committee of the National Grange, who, in concluding his address, said: "We do not believe that Federal Aid means the appropriating of National funds for local improvement of roads. It is certainly wrong to ask National aid to do what properly belongs to the local community to perform, and in any good roads movement the State is the unit to which the municipality should look for aid, and the State in turn to cooperate with the National Government for interstate roads and other roads that are of sufficient importance to warrant the employment of National aid in building. Any other course is untenable, unconstitutional, and basically wrong. But we do ask of the men who are trying, and conscientiously trying, to build interstate and transcontinental highways to remember the necessity of improving the road from the home to the city of the man who is promoting the great basic industry of our country to the end that all the people in this great country may ultimately be benefitted."

The resolution passed recommended the Federal Government to build and maintain an interstate system of highways connecting the capitals of the various States, and with the National Capital; the creation, wherever they do not now exist, of effective State Departments of Highways; a standing committee of Congress on National roads, a restoration of the tobacco tax of 1879, and the use of the excess in building a National or interstate system of highways.



CIVIC BEAUTY

Smoke Nuisance in Salt Lake City, Utah

By Jesse C. Coogan, Chief Engineer, Coogan Engineering Co., Milwaukee, Wis.

During the past three years I have made a special study of fuels and combustions, as they are a most important adjunct of my profession and business as a heating engineer, designer and contractor for large power plant equipment. Although I have had twenty-four years' practical and technical experience, it was only three years ago that I entered seriously into the question at issue, viz., fuels and combustion. Of late I have been devoting considerable study to the smoke nuisance in Salt Lake City, Utah.

Education and scientific firing will not cure the smoke nuisance in Salt Lake City, since it is impossible to legislate brains, intelligence and energy into the men behind the shovel that feed 95 per cent. of the heating and power boilers of the city, if the equipment they handle is not of a kind and arrangement by which they can secure smokeless results, and at the same time produce work intended.

Directly or indirectly, however, any legislation that will cause an abatement of the smoke nuisance will cause a gain and a profit, inasmuch as smoke issuing from a chimney represents just so much waste, as smoke is nothing more than minute particles of pure carbon carried off from the fire in gases that are insufficiently heated to burn.

The quantity of heat given to a boiler is determined by the final state of the gas escaping to chimney stack. If nearly perfect combustion has taken place in the furnace of a boiler, we are able to obtain an efficiency of as high as 75 per cent., by which is meant that 75 per cent. of the actual heat in the fuel is transmitted into work as represented by the heat generated by the boiler for heating or power purposes. The other 25 per cent. is a loss that cannot be avoided, as it represents loss resulting from radiation, due to boiler construction and gases escaping into stack, which are necessary to cause draft, etc.

Whenever dense smoke issues from a stack we can safely say that it represents 75 per cent. of the actual heat in the fuel that causes this smoke and the gases carried with it; therefore, Mr. Owner is losing just 50 per cent., or one-half, of what he could save if his furnace was of a type that turns this smoke and escaping gases into useful work by burning them at a high temperature and converting

JESSE C. COOGAN.

them into useful work. Therefore, any legislation compelling the use of furnaces that will not cause smoke will, per se, result in a direct economy and consequent saving in fuel.

It is for this reason that in cities that have compelled absolute obedience of smoke laws and ordinances, owners have learned the great economy of using smokeless types of boilers and are satisfied with them, after it has been driven into their heads by practical experience that instead of being a hardship the com-

pliance with anti-smoke laws is a benefit, inasmuch as it invariably results in a saving of fuel as well as a much higher efficiency from boilers.

A time-worn excuse for not installing smokeless boilers is the claim that there are not satisfactory ones on the market. This is a poor and false excuse, and there are several on the market at the present time, and the prices are most reasonable considering their many benefits.

Some of our foremost manufacturers of steel heating boilers have placed on the market in recent years various types of smokeless boilers, so that the question of price or availability should not be considered a legitimate excuse.

As a further evasion, some owners will claim that the mechanically operated stokers and furnaces are expensive to operate and require experienced and high-priced labor. For their benefit, I will say that there are several different makes of hand-fired smokeless boilers now in use in Salt Lake City.

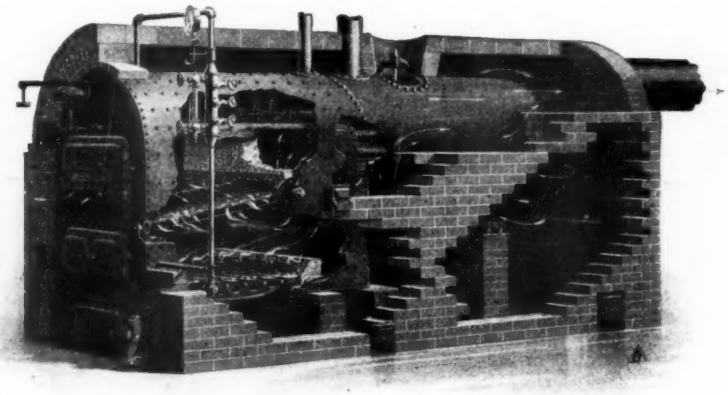
I recently installed three hand fired boilers, of down-draft type (Kewanee smokeless firebox boilers) for Granite school district. They have been found to be not only smokeless, but far more economical than any other type of hand-fired boiler in use in Salt Lake City, or elsewhere, where bituminous coal is available. These boilers above mentioned are used in connection with the Coogan hot-water system.

Various cities have smoke laws and most of them are effective. All thinking, sensible men will agree with me that scientific or intelligent firing by hand cannot be depended upon, and, therefore, other measures must be adopted to secure the desired results. As the question is a large one and concerns many owners of boilers, the solution cannot be arrived at in one day nor in one season, and hence I believe my suggestion as to the solution of this problem will be not only effective, but very reasonable. I suggest that a law be passed by the present legislature empowering Salt Lake City to create a commission on smoke abatement and have the members thereof appointed by the mayor, this commission to consist of not less than five members, two of whom shall be practical and experienced engineers and one a technical man of high standing. The other two members may be laymen if so desired. Then provide that any and all new boilers over 75 square feet of heating surface capacity must be of a type and size approved by the commission before installation.

Let the law provide that any and all boilers in use in Salt Lake City or within one mile of city limits must be inspected and approved and the owners furnished with a certificate of approval, without which certificate the commission will have authority to close down and seal up said boiler until proper arrangements are made to comply with the law. This section of the law will cause owners of present boilers to arrange to comply with the law. Provide a heavy penalty.

Also let the law provide that no stack or chimney shall emit dense smoke for a longer period than a total of five minutes in any hour of the day or night. This will permit of cleaning of fires once each hour, at which time some smoke may be necessary, although fires as a general rule are not cleaned more than two or three times per day.

Next I would allow any citizen to make a complaint against the owner or user of any smokestack or chimney that emits dense smoke for more than a total of five



TYPE OF FIRE BOX *used in Salt Lake City, Utah.*

minutes in any hour. Make each case a jury case, and if any kind of competent and reliable testimony is presented, you can take it for granted that Mr. Owner will generally and quickly be found guilty. The doubling up of fines is in use in Leeds and other English cities, and has resulted in almost a complete abatement of the smoke nuisance in those cities, where the poorest kind of coal is in use.

The chief commissioner should receive a large salary, and his requirements for office should be a complete practical and technical knowledge of heat and heating, as well as of fuel and combustions, so that complete confidence could be placed in the correctness of the rulings and in the judgment of the commission. The commission should be provided with a secretary, whose duty it will be to respond to calls of citizens regarding complaints. The secretary should be provided with a camera, and take photos of stacks every half minute when smoking, and be prepared to swear to the correctness of the photos and the time of taking, etc. This method is used in Milwaukee, and has resulted in one of the cleanest factory cities in the world.

Another great good accomplished by this commission would be the elimination of a lot of worthless devices that are palmed off on owners as "smoke consumers," "smoke preventers," etc., most of which wind up in the junk pile after only a short usage has proven them to be of no value whatever.

Practical and experienced stationary engineers would welcome a law of this kind, as it would compel a greedy owner to replace defective or deficient boiler equipment, which is notoriously unable to operate without smoking badly, no matter how much brain and brawn is furnished by Mr. Engineer or the firemen under his control.

Other details and duties of the commission could be worked out, but in the main the above will answer the purpose of positively cleansing the otherwise beautiful city of Salt Lake. I do not believe a single taxpayer or citizen possessed of an ounce of civic pride would or could object to the comparatively small expense that would be entailed in the adoption of this, the only positive remedy for a situation that is fast becoming unbearable to the pride and the health of the citizens of Salt Lake City.

Chicago May Rename Streets

The street nomenclature sub-committee of the city council of Chicago, after nine months of investigation, has submitted a report which would completely reorganize the street names of Chicago, and, it is claimed, for the first time in the history of the city, weaves them into a system that is concrete, easily understandable and practical.

If the changes go into effect they will be felt by practically every person in the city. They will mean corresponding changes in the names of elevated railroad stations, in telephone and city directories, and in addresses.

The committee's report is not final. It will go to the committee of streets and alleys, taxation, and street nomenclature, where objections will be heard. With such changes as are ordered by this committee it will go to the city council for final approval.

The plan followed in the report is that set forth in a letter written by Mr. Riley and made a part of the report of the committee on street nomenclature, published on March 4, 1912, in the council proceedings. This letter favored a system of street naming which would cover the following:

1. Elimination of all street name duplications.
2. Changing of all diagonal thorofares from avenues to roads.
3. Elimination of all numbered avenues on the west side and substitution of names.
4. Changes of all named streets which run east and west on the north side to numbered avenues in conformity with new numbers system.
5. Naming of all east and west streets between hundreds as numbered terraces.
6. Assigning of one name to all continuous thorofares now known by different names in different sections.
7. Establishment of alphabetical plan for renaming streets running north and south. Under this scheme a certain letter would be assigned for each mile, beginning with "A" for the mile west of the Indiana state line; all the streets within that mile being given names beginning with that letter.

The extent to which changes were necessary in following out this plan is indicated by the following figures: There are now in use in Chicago 1,761 street names. Of these 578 are duplications. The report now submitted eliminates 400 of these duplications. Of the total number of streets 885 are streets on the same line but with different names. Of these names 416 are eliminated by the report.

The total number of streets changed is 816. The alphabetical system suggested by Mr. Riley involved the assigning of 226 new names and twenty-three names have been assigned to streets hitherto without titles. The total number of streets remaining in the city, by the terms of this report, is 1,171. In other words, fifty-nine street names have been wiped out by the report.

PERSONAL

Illinois Water Supply Association

The fifth annual meeting of the Illinois Water Supply Association was held at the University of Illinois on March 11 and 12. The membership of the association is made up of water works engineers, superintendents, chemists and others interested in obtaining and conserving an abundant supply of pure water. The papers read at this meeting covered a wide range of subjects, including the study of deep well drillings in Illinois, sterilization of water by ultra-violet light, filter plants, practical methods of obtaining efficiency in water works pumping plants, bacterial examination of water supplies, conditions in small filter plants, appraisal of water works properties, fire streams and municipal laboratories. About 125 members attended the meeting. The officers elected for the next year are: President, C. H. Cobb, Superintendent, Kankakee Water Works; First Vice-President, H. M. Ely, Superintendent and Manager, Danville Water Company; Second Vice-President, W. J. Spaulding, Commissioner of Public Property, Springfield; Third Vice-President, V. E. MacDonald, Superintendent, Lincoln Water and Light Company, and Secretary and Treasurer, Professor Edward Bartow, Director, State Water Survey.

Association for Standardizing Paving Specifications

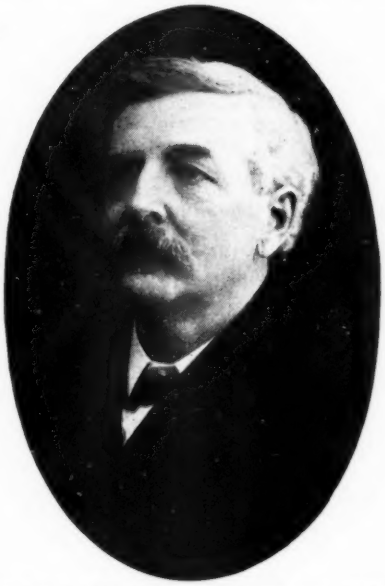
After two days of deliberation over changes in the specifications adopted at previous conventions, the Association for Standardizing Paving Specifications elected as president Norman S. Sprague, the superintendent of the Pittsburg bureau of construction; vice presidents, Nelson P. Lewis, New York; Geo. W. Tonson, Toledo, O.; Linn White, Chicago; W. P. Hempelmann, St. Louis; secretary and treasurer, John B. Hittell, Chicago. The question of amalgamation with the American Society of Municipal Improvements was voted upon and approved, with but two dissenting votes, and the method was referred to the executive committee with power to act at the Wilmington convention of the older society.

Practical Concrete Bridge Construction

By Will Dickinson, Contractor, Ridgway, Pa.

Will Dickinson is a contractor who believes in good materials and good workmanship and a fair profit, and he is building his share of concrete bridges in competition with steel.

In 1906, as closely as I could keep it from published statements of contracts let, the proportion of concrete bridges did not exceed 2 per cent., while in 1912 it was in the neighborhood of 40 per cent. The North Broad street bridge, opened



WILL DICKINSON, *Contractor, Ridgway, Pa.*

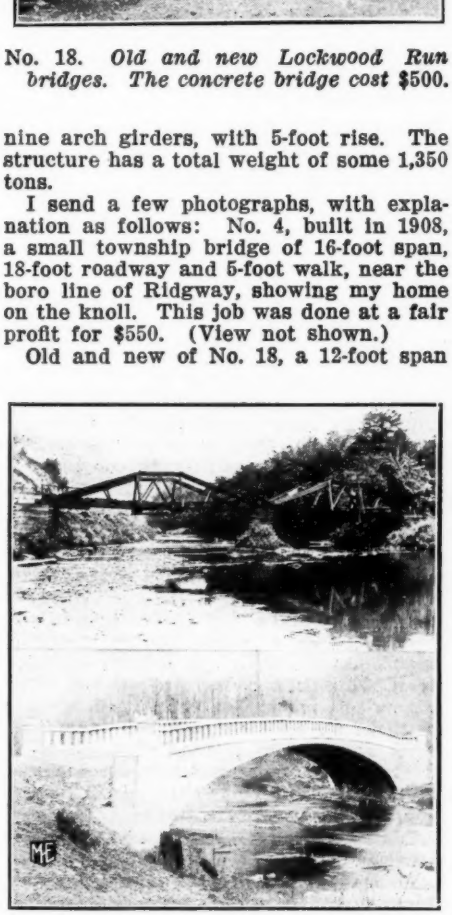
here in November (my No. 26), is 64-foot span, 35-foot roadway between curbs, two 7½-foot sidewalks, with balustrade rails,

No. 18. *Old and new Lockwood Run bridges. The concrete bridge cost* $500.

nine arch girders, with 5-foot rise. The structure has a total weight of some 1,350 tons.

I send a few photographs, with explanation as follows: No. 4, built in 1908, a small township bridge of 16-foot span, 18-foot roadway and 5-foot walk, near the boro line of Ridgway, showing my home on the knoll. This job was done at a fair profit for $550. (View not shown.)

Old and new of No. 18, a 12-foot span



No. 12. *Old and new bridges over Elk Creek, near Ridgway, Pa. Concrete bridge cost* $5,300.

at a dangerous place in a deep ravine at foot of a heavy grade, built for $500, some fourteen miles from home.

Old and new of No. 12, three miles from Ridgway, on Elk creek; 92-foot span, 16-foot roadway between balustrade rails; price, $5,300. Photographs taken just three months apart.

Advisory Good Roads Commission of the State of New York

Governor Sulzer, of New York, has appointed the following gentlemen as a special commission, to serve without compensation, for the purpose of collating facts and making such recommendations to the Governor as may seem fitting, with regard to the construction and maintenance of roads and the proper administration of the department of highways: James E. Gaffney, chairman, New York City; Geo. H. McGuire, secretary, Syracuse; Chas. E. Treman, Ithaca; Edward H. Butler, Buffalo; Col. William D. H. Washington, New York City; Prof. A. H. Blanchard, New York City; Paul L. Schultze, Troy; William Pierrepont White, Utica; Eugene W. Stern, New York City; John F. McDonald, Niagara Falls; Henry C. McCord, Merrick; Arthur A. McLean, Newburg; John J. Hopper, New York City; Gen. Amasa J. Parker, Albany; Augustus Thomas, New York City.

South Park Playground Director

The Chicago South Park commissioners have secured John R. Richards as director of their playground system. He succeeds Edward B. DeGroot, who has built up the playgrounds to their present state of efficiency, and has given them the reputation of being the best in the world. His selection of instructors, preparation of athletic and social programs and general management have been thoroly efficient and have made him a leader in the playground development of the country. It has not been easy to fill the place left by his resignation.

Mr. Richards is well qualified in athletic work. He began as a fullback on the Wisconsin University team and has been coach for a number of football and baseball teams, the most recent being Wisconsin and Ohio State Universities.

Albert Mohr

Albert Mohr, vice president of John Mohr & Sons, boilermakers, has been appointed a member of the Chicago South Park Board by the Circuit Court judges.

He will succeed Henry C. Foreman, whose term has expired and who resigned.

Mr. Mohr has been interested for the last thirty years in the small parks and playgrounds in the Calumet regions.

"We selected him," said Judge Adelor J. Petit, "because we know he has a kind heart, and that he is always planning something for the youngsters. He was ever trying to convert vacant lots into playgrounds, and it was surprising to see how he has succeeded."

Civil Service Examinations

The United States Civil Service Commission will hold examinations at the usual places as follows:

April 16, 17: Mechanical engineering inspector in quartermaster's corps of the army at $1,200 to $1,500 a year; junior engineer in water resources branch of Geological Survey at $1,080 to $1,200 a year.

Technical Associations

At the meeting of the Municipal Engineers of the city of New York, March 26, Foster Crowell presented an illustrated paper on the highways of America. On March 29, the society inspected the new subway construction, including the Chambers street station of the Brooklyn loop lines and the City Hall station of the Broadway subway. On March 15, the city tunnel of the Catskill aqueduct, was inspected.

The next meeting of the American Water Works Association will be held at Minneapolis, June 23 to 26. A special train will leave Chicago by the C. & N. W. R. R. Sunday evening, June 22, for convention attendants.

A housing exhibition is being held in the fourth, fifth and sixth floors of the City Club of Chicago by the club's committee on housing conditions, being open from March 17 to June 15. Dinner discussions were arranged for nine days in March and April. The prize competition plans for improving a typical flat quarter section of Chicago suburb are on exhibition.

The American Society of Engineer Draftsmen has moved its offices to 74 Cortland street, New York, to have room for its rapid growth. The society has a branch at St. Louis and one in Boston is just forming.

The fifth national conference on city planning will be held at Chicago, May 5, 6 and 7, with papers by such experts in the various phases of the subject as Frederick Law Olmstead, Virgil G. Bogue, George E. Kessler, E. H. Bennett, Milo K. Maltbie, on the technical planning and construction work; Edward M. Bassett, Charles H. Walker, William A. Magee, Dr. Werner Hegemann, on the executive, legislative and social features.

Technical Schools

Among recent lecturers before the graduate students in highway engineering at Columbia University, New York, were William H. Connell, chief of the bureau of highways and street cleaning, Philadelphia, Pa., on "Organization of Municipal Highway Departments;" John R. Rablin, chief engineer Massachusetts Metropolitan park commission, Boston, Mass., on "Metropolitan Park Systems;" John A. Bensel, New York state engineer, on "Interrelationship of Highways, Waterways and Railways;" Nelson P. Lewis, chief engineer of Board of Estimates and Apportionment of New York, on "Methods of Paying for the Construction of Street Pavements;" A. W. Dow, chemical and consulting paving engineer, New York, on "Manufacture of Wood Paving Blocks."

Personal Notes

DeWitt V. Moore, member American Society Engineering Contractors, has opened offices in the Merchants Bank Building, Indianapolis, as consulting engineer and architect.

Myron H. West, city planner, Chicago, has been employed by the city plan committee of the Chamber of Commerce of San Antonio, Tex., and will spend about a year in developing a plan for the future improvement of that city. Mr. West made a preliminary report early in March, covering all the items in the regular development of the city on which improvement is possible. The contract is contingent only on the failure of the people to vote for a bond issue to make improvements which are immediately necessary.

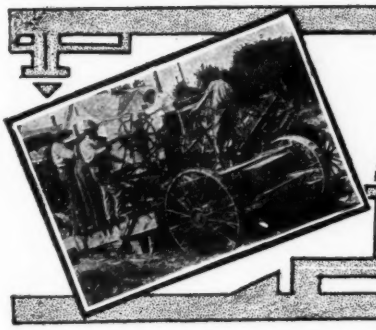
A. W. E. Fawkes has been appointed engineer in charge of water works at Calgary, Alta.

Lloyd McEntyre has been appointed bridge engineer of the New Jersey State Road Commission.

M. H. Baker has been appointed city engineer of Prince Albert, Sask.

William N. Ashplant has been appointed city engineer of London, Ont.

C. G. Elliott, member American Society Civil Engineers, former chief of the United States Bureau of Drainage Investigations, and A. D. Morehouse, assistant engineer, were reinstated in their positions by the last official act of ex-Secretary of Agriculture Wilson, thus fully vindicating these gentlemen of the charges made against them, which have been believed false from the beginning by those who know them.



MACHINERY AND SUPPLIES

Municipal Plants in Small Towns

The internal combustion engine, using a low-grade of oil, has made it possible for the small municipality to install light and water systems, and the majority of these plants are on a paying basis.

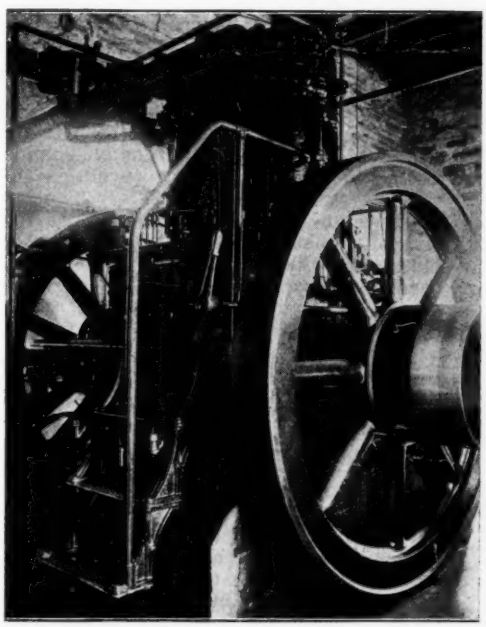
The city of Lucas, Kas., with less than 500 inhabitants, proves the above statement. Following is the report of the water and light plant of this city for the month of July, second month of operation, as furnished by H. H. Ingram:

Water rents collected	$ 81.47
Light rents collected	116.65
Total for July	$198.12
Cost of operation	$ 32.82
Fuel	3.00
Lubricating oil	1.45
Merchandise	60.00
Total	$ 97.27
Profit for July	$100.85

The above report does not include the current furnished the city of Lucas and used for the operation of forty-five 80-watt series street lamps. Had the plant charged the city for these lamps at the rate of $1.00 per month, it would have been shown a net profit of $145.85. This plant is furnished with a 50-h. p. Fairbanks-Morse oil engine.

The city of Osawatomie, Kas., has quite recently erected a light plant, equipping same with two 80-h. p. Fairbanks-Morse oil engines of the R. E. type. The generators, which are direct connected to the engines, were also furnished by Fairbanks, Morse & Co. The high potential lines carry a voltage of 2,300. This is transformed down to 220 and 110 for commercial purposes and 1,100 for the lighting circuit. At present the motor service is very light and until the use of high-power motors demands a change, the motors will be furnished current from the lighting circuit. This necessitates the use of single-phase motors until the motor load should increase to such proportion that the motor load would interfere with the lighting circuit, when it would be necessary to erect a separate circuit for motors only.

The city of Downs, Kas., installed its plant in 1895, equipping same with a 20-h. p. Fairbanks-Morse combined gas engine and pump. This plant has been in operation every day since its installation and its up-keep costs are said to be



COMBINED GAS *engine and pump, Fairbanks-Morse, installed for city of Downs, Kas.*

exceptionally low in spite of the fact that the cost of operation upon gasoline is high compared to the cost of operation upon oil. The estimated cost of operation of this plant per 1,000 gallons, however, is but 8 cents, and this estimate covers engineer's salary, fuel, repairs, etc. This plant paid for itself in a remarkable short time.

THE FREEMAN *revolving see-saw.*

Playground Apparatus

The piece of playground apparatus shown in the accompanying cut is a great attraction for the little folks. It has a revolving motion as well as the up-and-down of the see-saw, cannot upset and so is perfectly safe. The action is enlivened by the coil springs which are seen in the picture. The machine weighs 90 pounds, and when its 12 parts are securely packed the box, 9x14 inches and 5 feet 2 inches long, weighs about 125 pounds. The full size of the machine is 11 feet 8 inches long and 30 inches high. Nine bolts are used in assembling it.

Resurfacing Old Pavements

We have had considerable experience in the work of resurfacing and repairing old asphalt pavements and there is no question in our mind but that the surface heating method is the most economical and satisfactory.

We have a contract with the city of St. Louis, for repairing certain asphalt streets, aggregating about 140,000 square yards. When we started this contract we took up the old pavement and relaid it entirely with new material, but after the Lutz surface heater had been brought to our attention we discontinued that manner of making repairs and adopted the surface heating method, which was highly approved by the city authorities and we believe that we did more satisfactory work. The streets on which the Lutz surface heater was used are holding up splendidly and several of them have been done over three years.

It has long been a matter of common observance, that, when old methods are pursued, an opening repaired is never as good as the original undisturbed pavement, but the surface heating method enables these repairs to be satisfactorily made at a minimum expense and in such a manner that the place repaired cannot be detected, as no hummocks or depressions are left in the pavement. The constant pounding of traffic accentuates a more or less endless chain of repairs in every spot where there is the slightest raise or depression, and for this reason it is our opinion that the surface heating method will gradually gain in favor thruout the country.

City pavements are frequently cut into and it is stated that the useful life of a pavement is decreased fully 25 per cent. by these cuts and you may depend on it that just as long as electric ducts, telephone conduits, water mains, gas mains and sewers are beneath the streets just so long will street pavements continue to be opened up.

We have already repaired 40,000 square yards of asphalt pavement with the Lutz surface heater. New hot material does not weld or vulcanize onto old, cold pavements, even though painted with hot liquid asphalt. There being no union between the old and new material, cracks open up, admitting destructive elements, causing decomposition to set in.

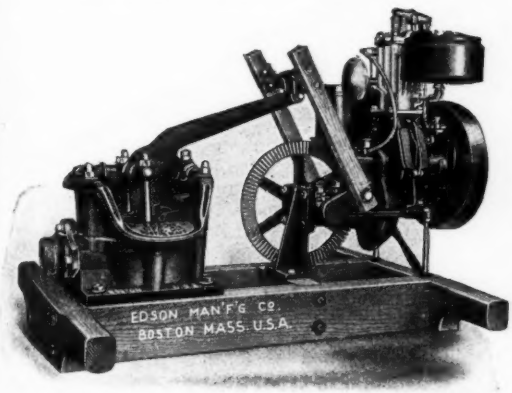
The Lutz method consists in drawing a large volume of air, heated to the proper temperature, from a heating chamber and blowing it with great force upon the asphalt or other bituminous pavement, thereby gently heating and softening without flame the old pavement to the same consistency as the new material. Then with the use of hoe and rake all disintegrated materials, uneven or worn surfaces are removed and joints

cut, and while the pavement is still hot sufficient new material to bring up the grade and contour of the street is added. The temperature of both materials being at the vulcanizing point, when tamped, smoothed and rolled a perfect weld is produced, leaving a finished surface. Instead of having a "patch," the repair becomes a part of the whole.

Gasoline Diaphragm Pumps

One of the most convenient, time and money-saving bits of apparatus the contractor can find is the gasoline power diaphragm pump outfit. A very efficient combination is manufactured by the Edson Mfg. Co., 285 Atlantic avenue, Boston, Mass.

The writer has seen the outfit at work on sewer trench and is qualified to confirm the claims of the makers of completeness, value and economy. In emergency cases in the sewer and water departments of the city or in wet trenches and foundations in the course of the contractor's



GASOLINE ENGINE *and diaphragm pump. Edson Mfg. Co.*

work they are invaluable. They are so easily set and moved and are so positive and reliable in their action that they are ready at any moment for any duty within their lift of 22 to 24 feet with plenty of reserve power beyond this required duty.

The Trus-Con Curb Bar

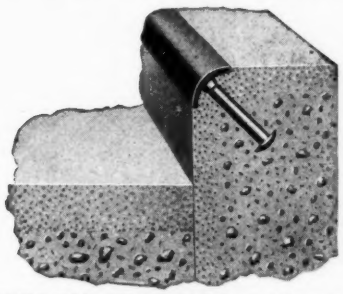
Recognizing the demand for a concrete edge protector that could be manufactured and placed on the market at a reasonable cost, the Trussed Concrete Steel Company of Detroit, Mich., evolved the Trus-Con curb bar. They claim for this bar an economical arrangement of every particle of steel used to protect concrete curbs, shipping platforms, step nosings, entrance and interior columns, or, in short, any

TRUS-CON *Bar No.* 1.

concrete edges exposed to strain incident to moving bodies, or as in curbs, to the added strain of temperature.

The Trus-Con curb bar No. 1 consists of two pieces of highest grade open-hearth steel, securely welded together, hot galvanized after forming. Plate ¼ inch thick, with periphery of 2½ inches. Anchor bolt 7/16 inch diameter and 4 inches long.

The Kahn System of reinforcing and finishing concrete in practically all of it thousands of applications, is extensively known, and is represented by offices in practically every large city on the globe.

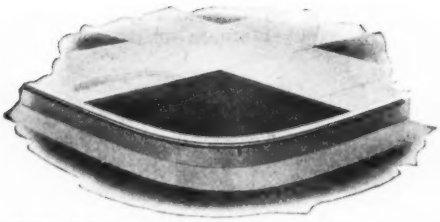


TRUS-CON CURB BAR *making possible the efficient concrete curb.*

The Trus-Con curb bar is one of the Kahn System products and the manufacturers submit the following reasons as claims of superiority for the engineer's consideration:

The very best possible arrangement of a minimum amount of steel to secure most satisfactory results.

The very best grade of steel for the purpose, heavily galvanized, and anchorage to the concrete that is absolute, and one that becomes an actual reinforcement in addition.



TRUS-CON CURB BAR *adapted for curved curbs at street intersections.*

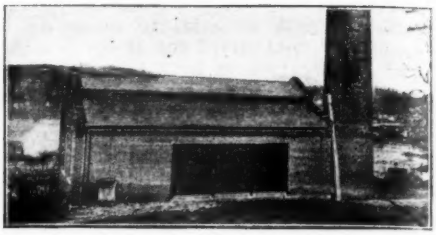
Simplicity of installation, as no special tools or detached parts are required.

Ability to distribute shock thruout the whole body of concrete.

Twenty-Five Ton Incinerator

By B. F. Miller, Jr., City Engineer, Meadville, Pa.

This city has been disposing of dead animals, rubbish, paper and waste from residences, hotels and restaurants since the year 1903 by means of an incinerator erected by the city at that time. This plant has a capacity of twenty-five tons per day and same is reduced to an odorless ash. Mostly all of this ash is dumped, although we do sell a considerable portion each month. All materials are collected tri-weekly by city wagons. These wagons drive direct from the roadway on to a steel platform and dump directly into steel hoppers directly over the incinerator proper. Our plant is built according to the patents of the Dixon Engineering and Construction Company, Toledo, Ohio, and is housed in a brick building. The initial cost of this plant was $8,232 exclusive of the lot, but is built in units and can be enlarged at any time.



INCINERATION PLANT *at Meadville, Pa. Note ideal location for unloading.*

During the period from January 1, 1911, to April 1, 1912, 2,294 tons of garbage were delivered at the incinerator. The total cost of operation, including labor, fuel and repairs, was 61½ cents per ton. Our coal costs us on an average of $2.65 delivered at the incinerator.

This incinerator plant is giving us very excellent satisfaction and the following is a report for the year ending Dec. 31, 1909:

FIVE UNITS *of Dixon Incineration Plant at Meadville, Pa.*

	No. loads refuse	Dogs	Horses
January	132	1	....
February	125	1	....
March	181	2	....
April	180	3	....
May	165	..	....
June	161	..	....
July	179	3	....
August	177	..	....
September	167	3	....
October	153	..	....

November	144	..	....
December	139	..	....
Total	1,903	13	....

Total cost of fuel.....$ 404.29
Total cost of labor..... 614.00

Total cost of operation.....$1,018.29

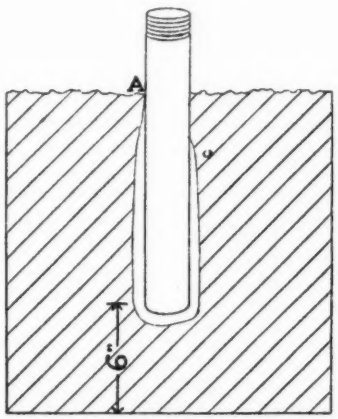
Making an average rate of $.535 per load.
Salary of operator, $2.00 per day.

Most cities make the frequent mistake of trying to realize too heavily on the disposition of their garbage and other waste whereas the first consideration of any municipality should be the disposal of this waste in the most sanitary and speedy manner regardless either of the value of the waste or the cost of the disposal. We believe that our method of incinerating our waste material is most effective from a sanitary view point as well as being exceedingly economical. The initial expense is, of course, always the greatest, but when a municipality installs an effective system, the upkeep and maintenance cost is so small that the total cost per ton for any number of years is infinitesimal.

Waterproofing Concrete Test

By Robert W. Hunt & Co., Engineers, Chicago

The following is a report of our "constancy of volume" test of a pat of neat cement made with water to which one-twelfth part of Ceresit had been added: This pat was made about 3 inches in diameter, ½ inch thick at the center and tapering to a thin edge as called for in the specifications of the American Society for Testing Materials. This pat was kept in moist air for a period of 24 hours and then subjected to an atmosphere of steam above boiling water in a loosely closed vessel for a period of 5 hours. The pat remained firm and hard and showed no signs of distortion, checking, cracking or disintegration.



The following is a report of our construction and tests of a concrete cube made with ceresit:

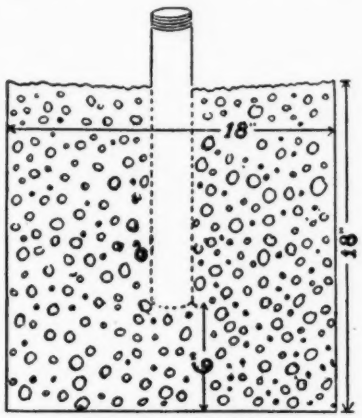
Construction of Cube

Under date of November 10th, we constructed a cube of concrete with a 2-inch pipe embedded in it as indicated in the sketch accompanying.

This cube was made from a mixture of one part Universal cement to two parts of torpedo sand to four parts of clean gravel, ranging in sizes from 1 in. to ⅛ in. In the mixing of this concrete the amount of water used was approximately 13 per cent of the total volume of cement, sand and gravel. To this water had been added a proportion of Ceresit equivalent to 13.75 lbs. to the cu. yd. of finished concrete.

Test of Cube

After aging 28 days in air a water pressure of 18 to 19 lbs. per square inch was applied in the pipe for a continuous period of 15 days. When this pressure had been applied about 2½ hours, the water commenced to seep up through the concrete at the location A in the sketch



- CROSS SECTION -

accompanying. This was due to the water backing up along the pipe at the junction of the pipe and the concrete. This leak stopped within 15 hours after it first showed and there was no sign of any subsequent leakage until the date of December 28.

On December 28 the pressure of the water in the pipe was increased to 100 lbs. per sq. in. and held there for twenty minutes without any sign of leakage. The pressure was then increased to 190 lbs. per sq. in. and held there for a period of

15 minutes, during which the water seeped to the top of the cube at the location A in the sketch. This seepage continued through the balance of the test.

The pressure was then increased to 370 lbs. per sq. in. and held for five minutes without any apparently greater seepage. It was then increased to 460 lbs. per sq. in. and held for five minutes with the same results. At no other location on the cube was there any seepage whatsoever, and it is significant that at the bottom of the cube, or the end opposite the open end of the pipe, and the sides of the cube, there was no dampness at all.

Upon the completion of these tests the 18-in. cube of concrete was split open when a careful examination of the broken cube showed permeation of water as indicated in the sketch accompanying.

It was then observed that in the setting of the pipe in the concrete the cement had flushed up into the pipe a distance of 1¾ ins. from the open end of the pipe.

It was apparent from a consideration of the direction of the seepage that said seepage backed up toward the top of the cube as a result, first, of the insufficient bond between the pipe and the concrete, and, second, for the reason that the concrete toward the top of the cube was less dense than that at the bottom.

Below is a complete report of tensile tests on briquettes made:

Universal Cement

7 day Neat	28 day Neat
No. 1—590	No. 6—852
No. 2—720	No. 7—875
No. 3—745	No. 8—860
No. 4—640	No. 9—940
No. 5—670	No. 10—940

Universal Cement with Ceresit

7 day Neat	28 day Neat
No. 11—705	No. 16—848
No. 12—630	No. 17—827
No. 13—670	No. 18—850
No. 14—575	No. 19—705
No. 15—565	No. 20—748

Universal Cement, Ottawa Sand

7 day 1-3	28 day 1-3
No. 21—265	No. 26—350
No. 22—250	No. 27—355
No. 23—260	No. 28—393
No. 24—290	No. 29—350
No. 25—285	No. 30—394

Universal Cement and Ottawa Sand with Ceresit

7 day 1-3	28 day 1-3
No. 31—290	No. 36—383
No. 32—285	No. 37—307
No. 33—295	No. 38—395
No. 34—290	No. 39—345
No. 35—290	No. 40—347

Twenty-one per cent water used on all neat briquettes.

Ten per cent water used on all 1-3 briquettes.

On Ceresit briquettes water used made up of 1 part Ceresit to 12 parts of water.

Universal Pumping Engine

By R. S. Adams, Chief Engineer Fire Dept., Petaluma, Cal.

We have in operation a universal combination motor pumping engine built by the Nott Fire Engine Company of Minneapolis, Minn. Two men are required to operate the engine and their salaries are $75.00 to $85.00 per month.

The wheels of this engine are made after a special design and are known as the artillery type. Each spoke is 3 ins. in diameter. The front wheels have 16 spokes and the rear wheels 18 spokes. These wheels are equipped with solid rubber tires of the very best make—42 ins. by 5 ins.

The special transmission is worthy of consideration, and we understand the cost of same is exceedingly high as compared with transmission of an ordinary engine. This engine delivers 600 gallons per minutes against 140 lb. pump pressure.

The almost total elimination of wear and tear to the apparatus through exercising is also of great importance. Horse-drawn apparatus has to go the rounds every day to keep the horses in shape, while the auto apparatus is simply "turned over" for a very short space of time, three times a day, to see if it is in working order.

The motor propelled pumping engine can be set at a hydrant and be pumping the water much quicker than the steamer as the engineer and his assistant can both give their undivided attention to the work of coupling the suction. In case of a fire close to the station, the motor propelled engine can be coupled to a hydrant and be pumping as soon as connections are made. There is no wait as in the case of the steamer, as the response to the shifting of the power to the pump is instantaneous and the speed and pressure can be maintained indefinitely without variation.

No comparison can be made in the matter of running expenses as between motor propelled pumping engines and horse-drawn apparatus, as expenditure for the former is almost at a standstill until a response to an alarm is made. On the other hand, the expense of maintaining a horse-drawn steamer is constant on account of the heater, horse feed, shoeing and wear and tear repairs in general.

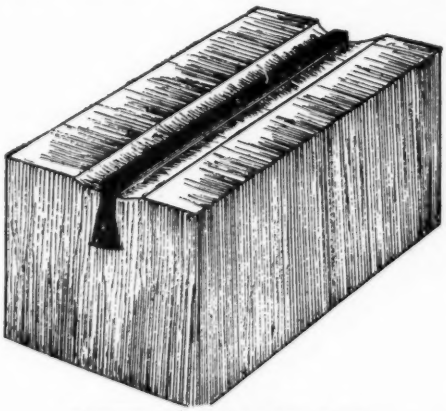
Again with motor propelled pumping engines sufficient fuel in the way of gasoline is carried for at least five hours' work, whereas with a steamer after working fifteen minutes fuel would have to be sent for.

It is my judgment and belief that a motor pumping engine, which is intended to take the place of the well-known and reliable steam fire engine, for fighting fires, will eventually be designed and perfected for the purpose. I do not believe it is possible for a gasoline fire engine to be successful unless all the parts are designed for the purpose by companies who know the requirements of a steam fire engine.

It is essential that all the working parts and construction of the engine must be in keeping with well known, durable construction of the steam fire engine. It is my belief that it is not the going to and coming from a fire that will lower the efficiency of the motor pumping engines, but it is the work that the engine is called upon to do when it is performing its duty in delivering its capacity with sufficient pump pressure to give a good fire stream when using from 300 ft. of hose in a line to as high as 1,000 ft. It is this constant horse power applied to the reciprocating parts of the engine and the pump that in my opinion makes it necessary to have the engine properly designed and constructed for the fire department use.

To Overcome Slipperiness in Wood Block Pavements

The insertion of a bar of steel in a groove at the bottom of a channel in the surface of a creosoted wood block is the basis of the patent on a safety wood block made by the National Safety Wood Paving Company, 1522 Real Estate Trust Building, Philadelphia, Pa. The channel is 2 inches wide and ⅜ inch deep, and in the center is cut a groove to hold the steel bar or grid, which is 1 inch deep, ¼ inch thick at its top edge and ½ inch at the bottom, thus locking into the block, as shown in the accompanying cut.



SAFETY *wood paving block.*

About half the blocks in a pavement are fitted with the grids and the combination of channel and grid gives the horse a chance for a footing, which is a great help in drawing heavy loads. Skidding of automobiles is also prevented in large measure. The grid blocks may be laid in several patterns. Probably the most popular will be with every other block a safety block, or every other row composed of safety blocks entirely.

The price of the blocks is not prohibitive. Full information will be furnished by the company.

Contractors' Grading Engine

The Reeves 25-h. p. simple double-cylinder contractors' grading machine is well-known among earth-moving contractors, as it is very extensively used for hauling, plowing and pulling elevating graders. The investment in such an engine is no greater than for the necessary number of mules, harness, feed and care, and more and harder work can be accomplished. The animals needed for hauling the grader can be used on dump wagons. More dump wagons mean more effective operation of the grader, less waiting and more yards of earth moved daily. Waiting for wagons is where a large part of the contractors' profit is dissipated.

The distinguishing feature of the Reeves' contractors' grading engine is the two simple cylinders with pistons connected to the same crank shaft, but at different angles. This prevents the engine from ever stopping on a "dead center" and the consequent provision of a heavy fly-wheel, found on single-cylinder engines, to carry it over center, and a clumsy clutch engaging with it to transmit power to the traction gear. The Reeves' simple double-cylinder engine will always start slowly, moving its load in the right direction, just as a railroad locomotive does. On the clutch-type of traction engine the fly-wheel must be running at full speed, generally 250 revolutions per minute, before the power can be applied to the traction gear. When this high speed is applied to the inert gearing, the engine starts ahead with a jump, often stripping cogs and breaking the coupling to grader.

As the nature of the work requires starting and stopping of the engine almost continuously all day long, it is easy to understand why the easy-motion Reeves meets the requirements so per-

REEVES *simple double-cylinder contractor's engine and elevating grader in a narrow, deep cut. A grader drawn by the usual number of teams could not be worked here to advantage.*

fectly with no expense for breakage and delay.

To afford close control of the engine the throttle is opened and closed by an overhead rod connecting with a bar supported by the cab posts. This bar has a long lever attached to either end so the throttle can be opened or closed from either side of the platform. This is a very desirable feature of a grading engine.

This engine has an exceedingly wide curving canopy cab extending over the entire platform while the sides are curved down to protect the operator from killing sunlight.

D. H. Blattner, a large contractor located at Tonasket, Wash., states that he has used his engine as above described for hauling his 50-ton steam traction shovel a distance of 18 miles. "We use this engine," states Mr. Blattner, "for a great variety of purposes. It gives excellent satisfaction in drawing our graders. We have a large cook house and office building on wheels and we have pulled this edifice, together with our heavy grading engine and four loaded wagons, a distance of 14 miles in less than 5 hours. By means of this engine and our elevating grader, we have frequently loaded as many as 1,360 1½-yard dump wagons in 10 hours. We used 18 wagons on this job, and could have loaded more if the wagons could have been gotten to the machine faster."

Orman & Crook, Belle Fourche, S. D., state that they have used one of these engines for hauling 35 cu. yds. of gravel in a train of 5 wagons a distance of 6 miles, and over grades of 12 per cent. "When conditions are favorable," states this concern, "we make two round trips daily. We figure the weight of the gravel at 2,800 lbs. per cu. yd. In addition to the gravel train we used our engine on grading machines. We have also used one of these engines as a steam roller on dam embankments. We once pulled one of our 12-ton dinky locomotives from Belle Fourche to the dam site over the country, on the engine's own wheels, without any trouble whatever."

Mineral Rubber Pavements

By C. L. Herron, City Engineer, City of Hillsdale, Michigan

Broad street, Hillsdale, Mich., which is laid with Sarcolithic Mineral Rubber Paving, is subjected to general traffic and carries almost all the traffic from the lake to the city. It covers 8,850 square yards, and mixed in a stationary machine and drawn in small carts to place of laying. This pavement is as nearly dustless as a pavement can possibly be and requires little sprinkling. All that is needed is flushing for the removal of manure and droppings from wagons. It is sufficiently resilient and rubbery to deaden and muf-

fie the impact of hoofs and iron tires, as well as absorb jars to those in vehicles.

The elasticity and give of the semi-gritty surface does away with slipping, skidding or sliding, as well as furnishing a firm foothold for horses, whether wet or dry.

Armored Division Joints

By Owen McKay, C. E., Walkerville, Ont.

There is no doubt in my mind but that improper expansion and contraction joints lessen the life of concrete pavements, inasmuch as the constant jar of heavy traffic and blows of hoofs against the unprotected edges of the expansion joints result in steadily increasing abrasion which eventually produces ruts.

We formerly made the expansion joint in concrete pavement by laying a ½-inch board, stiffened by a steel band top and bottom to prevent warping or bending, laying the concrete flush with the board on each side and when set removing the board and using it again at the next joint. These joints were placed 36 feet apart to come opposite the expansion joints in the curb, which are 6 feet apart. Before any public travel was allowed on the pavement the joints were filled with tar.

Two years ago we first used Baker steel plates 2½ inches by ¼ inch, with bars sheared out of the plates, with space between plates filled in with tar as before. We also laid No. 9 wire, 8-inch mesh, in the pavement just between the base and wearing surface from one expansion joint to the other. The No. 9 mesh wire was made in strips 4 feet wide by the width of the pavement with hooks and rods to fasten the pieces together.

In our first concrete pavement in Walkerville, which was laid in 1907, we found that the weakest part was at the joint, which rapidly wore away thru the action of heavy traffic. The temperature cracks between joints also caused trouble but not to the same extent as at the joints. In the latter part of 1912 we used three ply's of tarred felt paper between the steel plates at the joints instead of hot tar, which was more convenient.

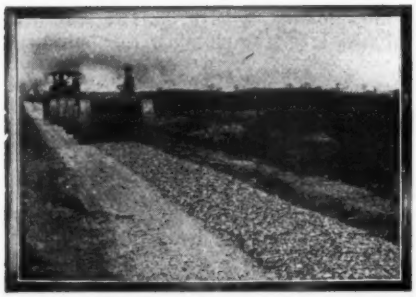
When the pavement got uneven we laid a thin coat of hot Tarvite over it and covered with coarse sand or fine gravel, making a uniform even pavement. This keeps the pavement in good condition for about three years if carefully laid and at a cost of about 8 cents per square yard. My opinion is that this covering should be put on as soon as the new pavement is laid and before it has any public travel in order to protect the pavement for the first year or until the concrete has thoroly hardened.

The Baker armored joints, which we are now using, insure a true and even joint absolutely flush with the balance of the pavement. All of our expansion and contraction joints are now protected against abrasion by means of these 3/16-inch soft steel plates, 2½ inches wide, which, being provided with shear members, are tied securely to the concrete base and wearing surface. The steel is open hearth, low in carbon and sulphur, this insuring even wear with the general concrete surface. These soft steel plates are clamped to steel division plates which, when joined, conform to the crown of the street. After the pavement is finished, and before the concrete has taken its initial set, the division plates are removed, and the opening is covered with tar paper until filled with tarred felt paper. We have adopted this method with great success and will state that these protection plates are made by the R. D. Baker Co., Detroit, Mich.

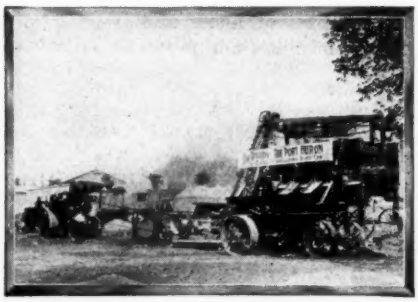
Vibrolithic

Vibrated concrete, according to R. C. Stubbs, its inventor, has vibration and pressure applied to it together, and the value of the product is said to be greatly increased in strength and evenness of texture, Mr. Stubbs claiming a gain of 30 per cent. easily, and 50 per cent. or more in many lean yet commercial mixtures. His explanation is that there is an increase in the density of the concrete without disturbance of the homogeneity of the mixture. When the process is applied to the construction of a concrete pavement the result is Vibrolithic.

Munger Place, Dallas, Tex., was laid with this pavement in 1910 by Mr. Stubbs. It is covered with one course of concrete, 5 inches thick, of 1:2:5.5 mixture, the stone being ½ to 1½ inches, mixed very wet in a batch mixer and delivered to place by chute. After leveling off with rakes, the surface was covered with 1 inch of ½ to 1-inch wet broken limestone. On this surface were laid 1-inch boards, flexible enough to follow the curvature. A motor supported on wide wheels and running at 1,000 revolutions a minute was run over the boards three times, the weight and vibration forcing the surface layer of stone into the mixture and producing a dense mass. This process, from water into mixer to end of vibration, requires about fifteen minutes. After each 50 feet of length of street was laid and vibrated, the transverse form was removed and the edge of the concrete was painted with bitumen, thus forming a contraction joint. No expansion joints were made. The pavement lay ten days under a quarter inch of sand before traffic was admitted. The cost was $1.25 a square yard.



PORT HURON *general purpose roller, hauling Port Huron spreading cars.*



PORT HURON *general purpose roller, driving rock crusher.*

Road Constructing Machinery

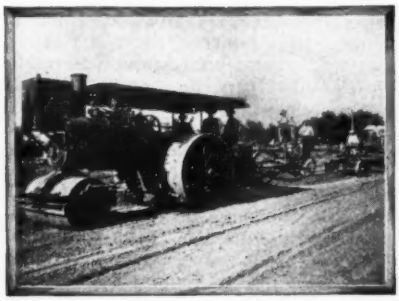
By A. N. Johnson, State Highway Commission, State of Illinois

Some kinds of machinery that can be economically used in a larger unit cannot be economically used in a town on account of the fact that the depreciation of these tools during the long part of the year they are not in use will more than make up for the saving effected by their use during a short part of the year. For example, if a township had a number of small concrete culverts to construct, it might be economical to purchase and use a small concrete mixer. A small mixer which will save nearly $1.00 per cu. yd. of concrete placed may be purchased for $300 or $400, so that if 300 or 400 cu. yds. are to be used in one or two seasons a small mixer suitable for larger work would seldom be economical for a town to own. Likewise, if a town has a large mileage of macadam roads to be maintained, it might be worth while to have a power roller for use in maintaining the macadam roads. But if, on the other hand, a small mileage is to be taken care of, the work can be done with the ordinary small tools in a satisfactory manner, altho not as cheaply as by use of the roller.

Road building machinery should be purchased only after a thoro investigation, especially in regard to the liability of breakdown and the expense of up-keep. The expense of repairs on road building machinery is very small in comparison with the loss which is occasioned by the disorganization of working crews by breakdowns. In deciding upon the purchase of machinery too much weight should not be given to the item of first cost, as the more expensive machine, in first cost, may be a far cheaper machine to operate.

If the road materials are expensive when shipped into the township, it may be advisable to maintain a quarry and crushing plant, but if materials can be obtained on board cars in the town at a price of $1.00 to $1.25 per cu. yd., it will not ordinarily pay the township to maintain a crushing plant unless it is expected to use it continuously thruout the season. If a considerable amount of gravel or crushed stone roads are to be maintained, it would be advisable for the town to own and use special dumping wagons which could be drawn by the tractor and used for hauling material for these roads.

If the type of soil and general characteristics of the roads of the townships are such as to permit the use of a power leveler which can take the place of the drag to a large extent, then this machine will be economical to use. If, on the other hand, the soil is of such a nature that it



PORT HURON *general purpose roller, hauling two graders.*

PORT HURON *general purpose roller, hauling scraper.*

River Parkway, Cambridge, Mass.

Cambridge's Experience With Tarvia

CAMBRIDGE, MASS., is another Tarvia town. Many of its roads have been built during the last five years with "Tarvia X" or treated with "Tarvia B." The streets of Cambridge carry an enormous automobile traffic and the problem of maintaining adequate road surfaces was a serious one.

During 1912 eight of the leading thoroughfares which had been built with "Tarvia X" received surface treatments with "Tarvia B" at a cost of 2¾c. per square yard.

The Superintendent of Streets of Cambridge reports: "This treatment not only preserves the surface of the road from raveling, but renders the street dustless to a large extent. It has been found to be the most economical way to care for tar-bound macadam."

In later years it will be found that additional annual treatments with "Tarvia B" will cost less each year. Westfield, N. J., for instance, found that roads which had been built with Tarvia, cost as little as 1¾c. per yard per year to maintain with "Tarvia B."

Towns which experiment with Tarvia get the habit, and in time settle down to its use as a matter of consistent policy. By this means they reduce their road costs and at the same time give greater satisfaction to the citizens.

Tarvia is a special combination of refined tars especially prepared for road use. It forms a tough, plastic matrix about the stone and prevents erosion and attrition. It is not a palliative, but a cure. It does not *suppress* dust so much as prevent the attrition which *creates* dust. Booklet on request.

BARRETT MANUFACTURING COMPANY

New York Chicago Philadelphia Boston St. Louis Kansas City Cleveland Cincinnati Minneapolis Pittsburgh Seattle Corey, Ala.

The Paterson Mfg. Co., Ltd.—Montreal, Toronto, Winnipeg, Vancouver St John, N. B., Halifax, N. S.

cannot be traveled by a tractor drawing a leveler at the time of the year when the leveler should be used, it will be necessary to resort to the use of the drag drawn by teams, and a power tractor, and the leveler would not be an economical piece of machinery for the town to maintain. On light clay and gumbo soils, a leveler can be used to good advantage.

There is no class of machinery used in road building in which there is so wide a difference in construction and design and first cost as in the steam rollers. I think that it is generally conceded by road builders, and it has been my own experience, that a double-cylinder steam road roller is better adapted for road construction than any other type. There is no class of road building machinery which has been so highly developed. The wide variation in first cost of the different steam rollers makes it very difficult for a contractor or town official to make up his mind which one ought to be purchased. There is almost as much difference in road rollers as there is in watches. You may purchase a watch for a dollar which is liable to keep good time for a year, and it is liable not to do so. You may purchase a watch which costs almost any price, and in every case you will probably get just what you pay for. As a general thing the higher the price up to a certain limit, the more dependable the watch is, and the same rule applies to road rollers. There is no road building machinery sold that I know of upon which an exorbitant profit is being made. In looking over a road roller with the view of purchasing, particular attention should be given to an investigation of the gearing and wheels. You can tell by the looks of the wheels and gears upon the machine which has been in use, whether or not that machine is going to do your work day in and day out as it ought to. A set of rear wheels should last, under ordinary service, at least ten years. I have wheels which have been in service fourteen years and are good, I think for one more. The gearing on steam rollers should be of steel and cut and fitted as nicely as in any high-class automobile construction. Gears should be closed so as to exclude dust.

During the year 1912, we constructed the following amount of experimental road work:

1912	*Sq. Yds.*	*Cost.*
Waterbound macadam	177,349	$118,328.00
Bituminous macadam	121,589	98,393.00
Concrete	26,509	23,154.00
Waterbound macadam resurfaced	21,971	1,658.00
Bituminous resurfacing	44,892	12,226.00
Bituminous resurfacing on old macadam	33,674	4,418.00
Brick pavement (Elgin)	10,017	15,000.00

The cost of engineering, supervising and inspecting experimental roads in the State of Illinois from 1908 to January 1, 1913, was as follows:

Cost of work constructed	$ 650,183.00
Sq. yds. of road constructed	1,055,501
Cost of 1,055,501 sq. yds. road	$624,319.00
Total cost of engineering, superintendence and inspection, including office expenses for all work	87,466.00
Less cost of engineering furnished on roads not built by the commission— 25 miles at $50.00	$ 1,250.00
Less cost of supervision of non-experimental roads using penitentiary stone	1,335.00
Total expenses not chargeable to experimental roads	$ 2,585.00
Cost of engineering and supervision on experimental roads	$ 84,881.00
Percentage of total cost of experimental roads expended for engineering, superintendence and inspection	13%
Cost per sq. yd. finished road for engineering, supervision, and inspection	$0.059

The Morse Destructor Furnace

Notice is hereby given that the business of contracting and construction of destructors and incinerators under my patents has been assumed by the Griscom-Russell Company, 90 West street, New York City, to whom all inquiries relating to this destructor should be addressed. No other person or company has any right or control of my patents or constructions in all the various forms designed or built by me.

W. F. MORSE,
90 West Street, New York.

Iroquois Iron Works Now the Barber Asphalt Paving Company

It is announced that hereafter the business of the Iroquois Iron Works, of Buffalo, N. Y., will be carried on under the name of the Barber Asphalt Paving Company. This, however, will involve no change in management or policy, and "Iroquois" will be retained as the trademark name of the Barber company's paving and road-making tools and machinery.

Some twenty years ago, when a large demand first arose for the machinery and tools necessary for asphalt paving, the Iroquois Iron Works were established and soon became known as the machinery department of the Barber company. In former years, when contracting was the most

The SARCO Asphalt Case

Culmer Patents Number 635429 and 635430

Decree of Hon. Christian C. Kohlsaat, United States Circuit Judge, Filed March 3, 1913, Sustaining above Culmer Patents on Process and Product and Holding them Valid and Infringed.

Charles K. Offield,
Albert H. Graves,
F. L. Belknap, *Of Counsel.*

OFFIELD, TOWLE, GRAVES & OFFIELD, *Solicitors for Complainant.*

UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF ILLINOIS

EASTERN DIVISION

STANDARD ASPHALT AND RUBBER COMPANY, Complainant
vs.
AMERICAN ASPHALTUM & RUBBER COMPANY, et al., Defendant

IN EQUITY. Bill for Infringement of Patents.

DECREE

This cause came on to be heard upon final hearing on bill, answer, replication and proofs taken and filed herein on behalf of both parties, and was argued by counsel for the respective parties—Charles K. Offield and Albert H. Graves for complainant, and Edward Rector and Charles C. Bulkley for defendant; and thereupon after due proceedings had and the Court being fully advised, it is upon consideration—

ORDERED, ADJUDGED AND DECREED, as follows:

I.

That (1) Letters Patent of the United States, in complainant's bill of complaint sued upon, granted George F. Culmer and George C. K. Culmer, under date of October 24, 1899, for new and useful Improvements in Processes of Making Asphaltic Fluxes, No. 635,429, and (2) Letters Patent of the United States granted George F. Culmer and George C. K. Culmer, dated October 24, 1899, for new and useful Improvements in Asphaltic Fluxes, No. 635,430, are good and valid Letters Patent, respectively; and that said George F. Culmer and George C. K. Culmer were the *original and first inventors of the processes and improvements described and claimed* in said letters patent, respectively.

II.

That the complainant, Standard Asphalt & Rubber Company, is the lawful owner of, and entitled to, the exclusive right and title in and to said letters patent, and in and to the inventions and improvements respectively thereby secured.

III.

That said defendant, American Asphaltum & Rubber Co., by reason of the practice of the process described and claimed in said Letters Patent No. 635,429, and the production of the product described and claimed in Letters Patent No. 635,430, and in complainant's bill of complaint set forth, has infringed the single claim, respectively, of each of said above letters patent—Nos. 635,429 and 635,430, and has violated the exclusive right of the said complainant thereunder.

IV.

That the said complainant does recover of the defendant, the gains and profits made by it, and the damages sustained by complainant by reason of such infringement.

V.

That it is hereby referred to Charles B. Morrison as Master, to ascertain the amount of such gains and profits made by the defendant, American Asphaltum & Rubber Co., and the damages sustained by said complainant, by reason of such infringement, and that complainant, on such accounting, has the right to cause an examination of the officers of said defendant, American Asphaltum & Rubber Co., ore tenus, or otherwise, and also the production of the books, documents and vouchers of said defendant, and that said defendant attend for such purposes before said Master from time to time as said Master shall direct.

VI.

That a writ of injunction, according to the prayer of said bill of complaint, be issued out of and under the seal of this Court, restraining and enjoining said defendant, American Asphaltum & Rubber Co., its officers, attorneys, agents, employes, servants, workingmen and all others acting by or under its authority, from any further infringement of said Letters Patent Nos. 635,429 and 635,430, respectively, and of the exclusive right of complainant, Standard Asphalt & Rubber Co., thereunder.

VII.

That complainant, Standard Asphalt & Rubber Co., recover of the defendant, American Asphaltum & Rubber Co., its costs and disbursements of this suit, to be duly taxed, and that the question of increased damages be reserved until the coming in of the Master's report.

Dated at Chicago, Ill., March 3, 1913. **CHRISTIAN C. KOHLSAAT, Judge.**

important division of the company's business, it was the largest user of rollers and paving apparatus in general. It could not buy from others the machinery and tools it required, and therefore made them for its own use, as well as for sale to others. In this way the Iroquois line developed as an embodiment of the requirements of the paving contractor and was constantly improved by the experience of the manufacturers as paving contractors. Iroquois rollers, both tandem and macadam, are now found the world over. The Iroquois output also includes heating kettles, surface heaters, mixers, and hand tools of every kind.

Publications Received

Regulation, Valuation and Depreciation of Public Utilities, by Samuel S. Wyer, M. E., consulting engineer, Columbus, O. Leather, 313 pp., $5. Sears and Simpson Co., Columbus, O.

The Regulation of Municipal Utilities. Edited by Clyde Lyndon King, Ph. D. National Municipal League Series. Cloth, 404 pp., $1.50 net. D. Appleton & Co., New York and London.

Valuation of Public Utility Properties. By Henry Floy, M. A., M. E., consulting engineer, Mem. A. I. E. E., Am. Soc. C. E., Illum. Eng. Soc., N. Y. Elect. Soc., etc. Cloth, 390 pp., $5 net. McGraw-Hill Book Co., 239 W. 39th street, New York.

Valuation of Public Service Corporations; legal and economic phases of valuation for rate making and public purchases. By Robert H. Whitten. Cloth, 789 pp., $5.50. Banks Law Publishing Co., New York.

Engineering Valuation of Public Utilities and Factories. By Horatio A. Foster, consulting engineer, Mem. A. I. E. E., A. S. M. E. Cloth, 350 pp., $3 net. D. Van Nostrand Co., 25 Park Place, New York.

Lefax is a series of data sheets giving data on all engineering subjects, similar to *Data*, which was published for a short time in Chicago, which can be filed as desired. $1 a year, entitling subscriber to 100 data sheets and special terms for special subjects. Standard Corporation, Pennsylvania Building, Philadelphia, Pa. ference.

Manual for Engineers, issued by the University of Tennessee, 70th thousand. Leather, 50 cents. Knoxville, Tenn.

Auditing: Theory and Practice. By R. H. Montgomery, C. P. A., president Am. Ass'n of Pub. Accountants. Half leather, 700 pp., $5. The Ronald Press Co., 198 Broadway, New York.

Replanning Small Cities. Six typical studies by John Nolen, F. Am. Soc. Landscape Architects. Cloth, $2.50 net, 20 cents postage. B. W. Huebsch, 225 Fifth avenue, New York.

The Isolated Plant is a magazine devoted to private power and light plant installations.

The "Toxement" booklet for 1913 is issued, describing this waterproofing for cement construction.

The American Asphaltum and Rubber Company, Harvester building, Chicago, is circulating a booklet containing a description of the successful waterproofing of the Webb City (Mo.) concrete reservoir of 1,300,000 gallons capacity with Pioneer reservoir waterproofing asphalt.

Reducing coal consumption and increasing the efficiency of the power plant by using the Lea V-notch water-flow recorders is demonstrated in a booklet of the Yarnall-Waring Co., Philadelphia, Pa.

The Humboldt Mfg. Co., Chicago, issues a new price list of asphalt and cement testing laboratory apparatus under date of March, 1913.

Graphite is the house organ of the Joseph Dixon Crucible Co.

The Jewell Nursery Co., Lake City, Minn., issues a catalog of hardy trees and plants.

Miller flush tank siphons for shallow depths are the subject of Circular No. 8 of the Pacific Flush-Tank Co.

The Ruggles-Coles Engineering Co., New York, issue a circular on their road machines, including portable and semi-portable dryers, heaters, mixers and their combinations for various kinds of road and pavement construction.

Trade Notes

The Northern Fire Apparatus Company of Minneapolis has recently reorganized the sales department of its business. G. P. Williamson has become identified as a member of the firm and will assume the active management of sales. Mr. Williamson is an experienced apparatus man and in addition has served an extended period in sales management. The Northern Company has always made a specialty of volunteer department apparatus, and the remarkable growth of its business has necessitated this addition to its management.

J. W. White, engineering salesman for the Jeffrey Mfg. Co., will hereafter look after the sales of the above company in eastern Minnesota, northern Wisconsin and the upper peninsula of Michigan, with headquarters at 1905 East Superior street, Duluth, Minn.

The Raymond Concrete Pile Co. of New York and Chicago have been awarded a contract for placing 2,047 standard Raymond concrete piles for the foundation of the new Rock Island elevator, Kansas City, Kas. The MacDonald Engineering Co., Chicago, are the general contractors.